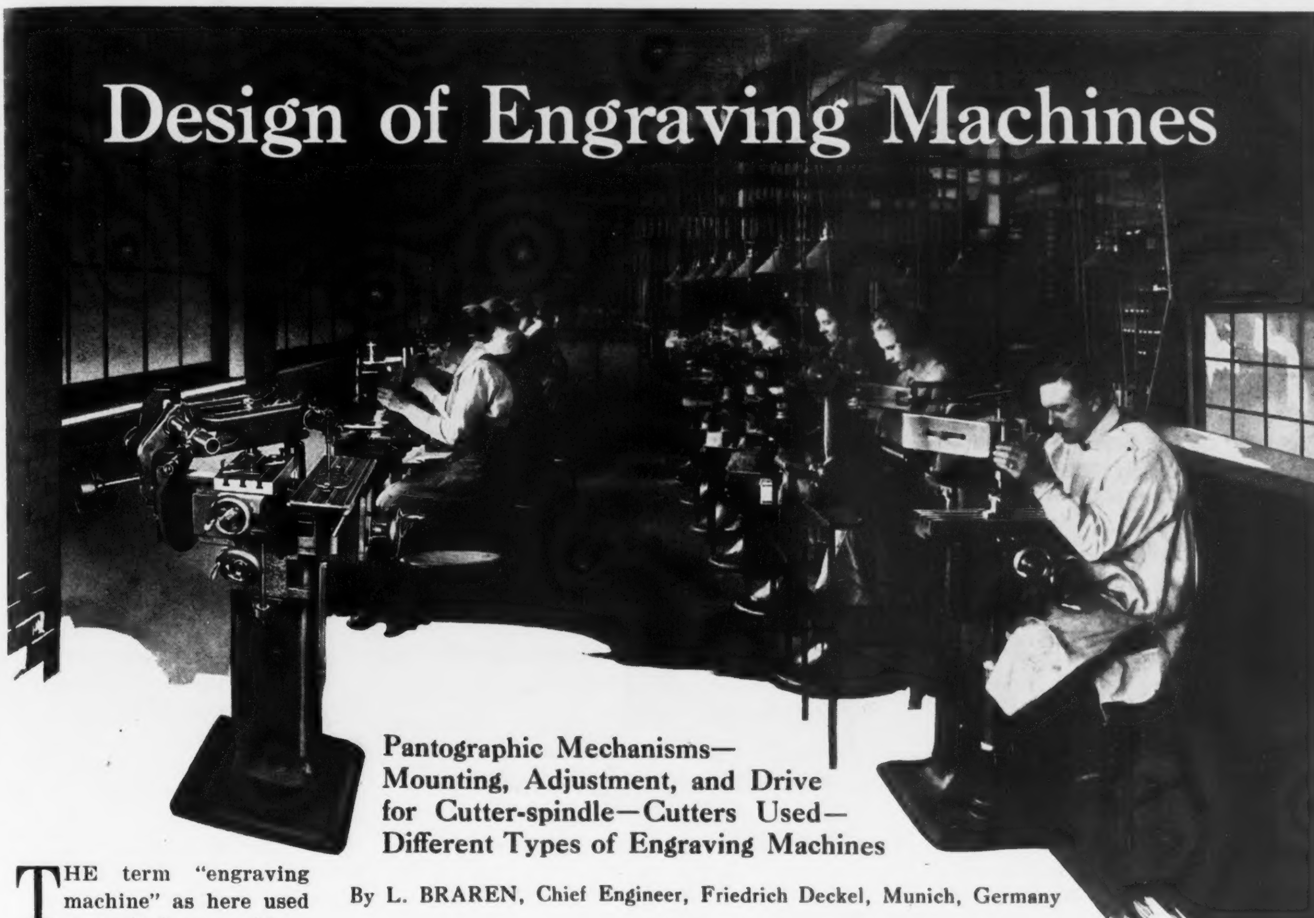
Volume 30 MAY, 1924 Number

MACHINERY

THE INDUSTRIAL PRESS Publishers, 140-148 LAFAYETTE ST., NEW YO

Design of Engraving Machines



Pantographic Mechanisms—Mounting, Adjustment, and Drive for Cutter-spindle—Cutters Used—Different Types of Engraving Machines

By L. BRAREN, Chief Engineer, Friedrich Deckel, Munich, Germany

THE term "engraving machine" as here used is applied to machines for reproducing a design, or some combination of letters or figures, from a suitable master at the same or a reduced scale, where a cutting tool is guided in two directions by grooves in this master. Such a machine consists of the frame and the following principal units: A table for receiving the master or copy; a table for locating the work-piece; a cutting tool, arranged, as a rule, to rotate, and equipped with bearing, drive, and axial adjustment; and a mechanism for transmitting the movement from the master to the cutting tool.

The transmitting mechanism from the master to the cutter is, as a rule, a pantographic system of which three forms are shown in Fig. 1 at *A*, *B*, and *C*. The point where the system is suspended is at *a*; *f* is the tracing stylus, and *s* the cutter-spindle. Arrows beside the different joints indicate the adjustments which have to be made for a different ratio of reduction. In order to attain an exact reproduction, it is necessary that in each position of the pantograph the three axes *a*, *f*, and *s* remain in a single plane, parallel to each other, and at a distance corresponding to the desired ratio of reduction. This ratio depends on the proper adjustment along the arms of the pantograph. Opposite sides of the parallelogram must be of exactly the same length, and the three axes *a*, *f* and *s* should be perpendicular to the plane of the parallelogram.

Vibrations caused by the cutting pressure should be eliminated by a stiff construction of the members and a good design of the joints. The pantograph mechanism, however, should move easily in order not to fatigue the operator guiding it. The cutting spindle at *B* and *C* is supported by the pantograph, while the pantograph represented at *A* only transmits the movement to the cutting spindle, which is carried separately by two jointed links. The ratio of reduction between the work and pattern obtained with a pantograph such as shown at *A* may be varied from 1 to 1 down to any smaller scale due to the arrangement of the pantograph mechanism. For a reduction between work and pattern of from 1 to 1 down to 1 to 2, the tracing stylus is removed to a second point f_1 to decrease the leverage. This arrangement results in an easy movement, as the cutter-spindle and pantograph are kept separate.

The pantograph shown at *C* does not move quite so easily as the one just referred to, but it is more rigid. The reductions with such a pantograph may be varied from 1 to 1 down to 1 to 10. The construction at *A* is preferable for machines intended for light and medium work, while the design at *C* is especially suitable for heavy engraving cuts. At *B* the cutter *s* is arranged between the support *a* of the pantograph and the tracing stylus *f*, so that only a part of the cutting pressure corresponding to the ratio of leverage, is transferred to the supporting shaft; this shaft, however, with the arrangements shown at *A* and *C* withstands, besides the thrust of the cut, the thrust taken by the stylus. Design *B* has greater stability, and is especially

---

In view of the extensive application of engraving machines of different types in both the machine-building field and numerous other industries, the specific information in this article on the subject of engraving will doubtless prove of interest and value to many manufacturers utilizing engraving machines. The principles underlying the operation of different designs of engraving machines are explained; various forms of pantographic mechanisms are described and illustrated; and information is included on the different types of cutters and machines that are employed in European practice.

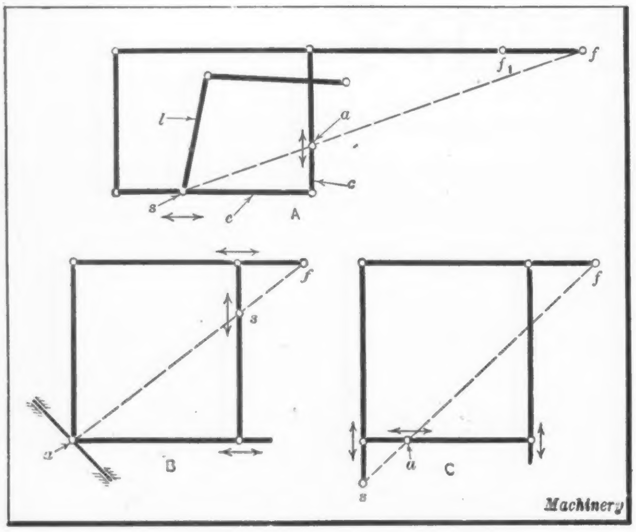


Fig. 1. Three Types of Pantographic Mechanisms

adapted for work requiring very heavy cuts. A disadvantage of this construction lies in the fact that the space for the work is limited to that between the tracing stylus and the supporting point, but it is very favorable in that a second axis may be arranged at right angles to the supporting shaft (as indicated in the diagram) so that the same machine may be used for the reproduction of plastic models. Milling out dies to obtain a reproduction of a model is an example of the work performed with the latter arrangement.

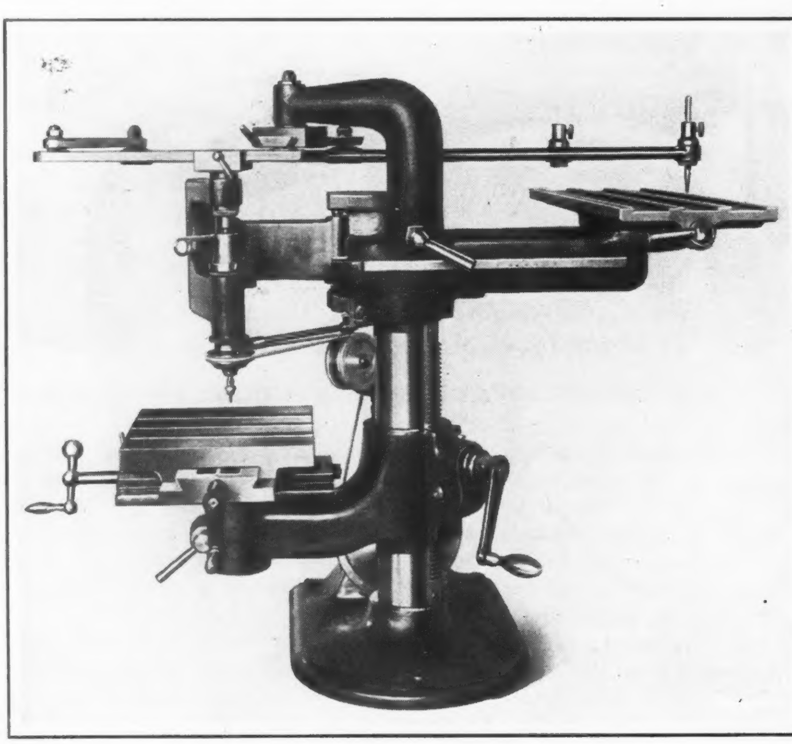


Fig 2. Engraving Machine of Bench Type

Fig. 3 is a section through the side *e* of the parallelogram shown at *A* in Fig. 1, with the support *a* moved to coincide with the center line of the right-hand pivot. Usually one of the sides of a pantograph is mounted simply on plain pins of ball shape, which soon develop a small amount of play that is detrimental for precision work. To avoid this, all pivot shafts are arranged without play in adjustable single-row ball bearings of ample size. The small amount of movement desirable for equalizing any minute inaccuracy in manufacturing or assembling is provided by the ball-shaped bushing *m*, which, however, does not turn, but only oscillates and moves axially very slightly; consequently wear is reduced to a minimum. The links or arms *e* and *c* of the pantograph are of trapezoid cross-section, and the sliding members *h* and *k* of the pantograph carrier *g* and the cutter-spindle bearing *l*, are scraped to fit these arms accurately.

The Cutter-spindle

The mounting of the cutter-spindle is a very important part of an engraving machine, because a satisfactory bearing must fulfill quite a number of requirements. The cutter journals should be without the slightest play, either in axial and radial directions, because the least amount of play would show in the engraving cut. At the same time, the frictional resistance of the bearing should be as low as possible, as a very high speed is necessary for the narrow cuts generally taken. A cut 0.020 inch wide and a spindle speed of 10,000 revolutions per minute result in a cutting speed of only 52 feet per minute, while the finest of hair-line engravings required in the optical, instrument, and watch industries have widths as small as 0.001 inch.

The drive for the cutter-spindle should not transmit vibration to the spindle. At the same time, the spindle has to follow readily every movement of the pantograph without causing unusual belt tension. Finally a sensitive axial adjustment of the cutter must be provided for regulating accurately and easily the depth of cut desired. A quick feed, besides the usual slow feed, proves advantageous for advancing and removing the cutter quickly, while an adjustable stop is very serviceable for limiting the depth of the cut.

Bearing for the Cutter-spindle

Experiments extending over a period of several years have demonstrated that the two bearings shown in the Figs. 4 and 5 possess special merit. The bearing in Fig. 4 is a plain type, with two adjustable conical surfaces at opposite ends of the spindle. To insure a constant stream of lubrication, a spiral groove has been cut in the spindle to carry lubricant from the lower to the upper bearing surface when the spindle is rotating. The oil having passed through the upper adjustable bushing, returns through channels into a reservoir surrounding the center portion of the spindle, and flows through openings in the lower fixed bushing back again to the lower bearing of the spindle, thus completing the circuit.

Fig. 5 shows a spindle carried by two angular-contact ball bearings, so arranged that any slight wear may be taken up by adjusting two nuts. To lubricate the spindle, the complete bearing is removed from the carrier, as will be described more fully

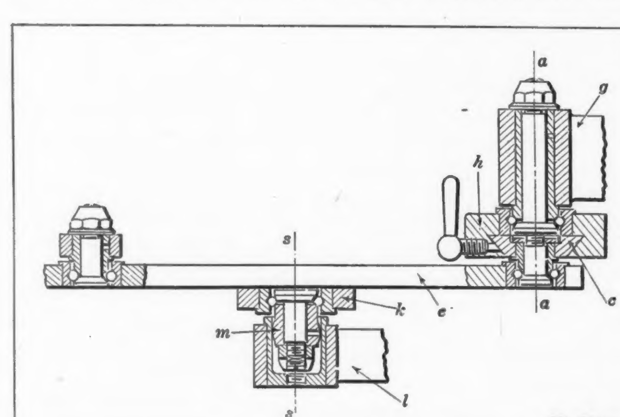


Fig. 3. Pantograph Bearings

later, and a grease-gun *P* is used to force grease through an opening *C* into the bearing, completely filling the interior space. This need only be repeated every four to eight weeks. Besides the advantage of being practically independent of lubrication, a ball-bearing spindle does not need any clearance for an oil film, and may be employed at very high speeds without causing trouble.

Drive for the Cutter-spindle

The driving of a spindle that is free to move at right angles to its axis, from a stationary shaft, has been done in different ways. Several short round belts may be employed with the sheaves located on the turning pivots of the links, or a single belt may transmit rotary motion from a driving pulley over guide rollers to the driven spindle, a rod being used to keep the guide rollers at a uniform distance from the driven spindle. The guide rollers are carried by a link fastened to the frame of the machine and move at right angles to the axis of the spindle. The driving pulley is located perpendicularly above or below the central position of the guiding pulleys at as great a distance as possible.

The first arrangement has the disadvantage of using several short belts, which wear quickly and also cause vibrations by the passing of the connections over the sheaves. Endless belts cannot be used very well on account of the position of the sheaves on the pivot pins of the links. With large movements, the second drive exerts a belt pull tending to bring the spindle back into the central position. The common construction of journaling the drive and spindle separately, with a connecting member between, removes the direct belt pull from the spindle, but does not avoid the transmission of vibrations; in fact, this arrangement may even be the source of an additional vibration synchronous with the number of revolutions, in case the axes are not mounted exactly in line, due to small inaccuracies in manufacturing or assembling.

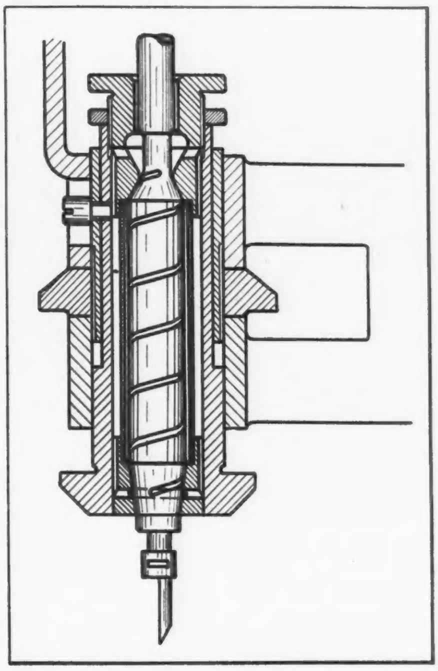


Fig. 4. Cutter-spindle Mounting—Plain Bearings

In the design shown in Fig. 9, the spindle-driving problem has been solved in a simple manner, avoiding all objectionable features. The belt, on its course from the driving to the driven pulley and back again, passes over two guide pulleys at *D*, which are mounted on an arm *E*. The latter is pivoted to lever *B*, and a connecting-rod *F* holds the idler sheaves in proper relation to the driven pulley; consequently, the total length of the belt is not varied by movements of the cutter-spindle. Vertical adjustments of the cutter-spindle cause a turning movement about an axis at *C*, which is located to cross the belt line so that no variations in length occur. The belt may be tightened by adjusting the connecting-rod *F* through clamp-screw *H*. The weight of the moving parts is compensated for by a counterweight. The shaft *A* is either driven by an electric motor mounted on the frame of the machine, as shown in the illustration, or by a belt drive from a countershaft. Both belts are made endless to prevent vibrations due to the connecting joints.

Axial Adjustment of Cutter-spindle

The quick and slow adjustments obtained with the design shown in Fig. 5 are used to lower the cutter quickly on the part to be engraved and to regulate accurately the depth of cut. This construction may be used without change for engraving on flat work or for guiding the cutter to a predetermined curvature. It will be seen that a lever *F* is pivoted on a pin fastened in a bushing *E*. In lowering the

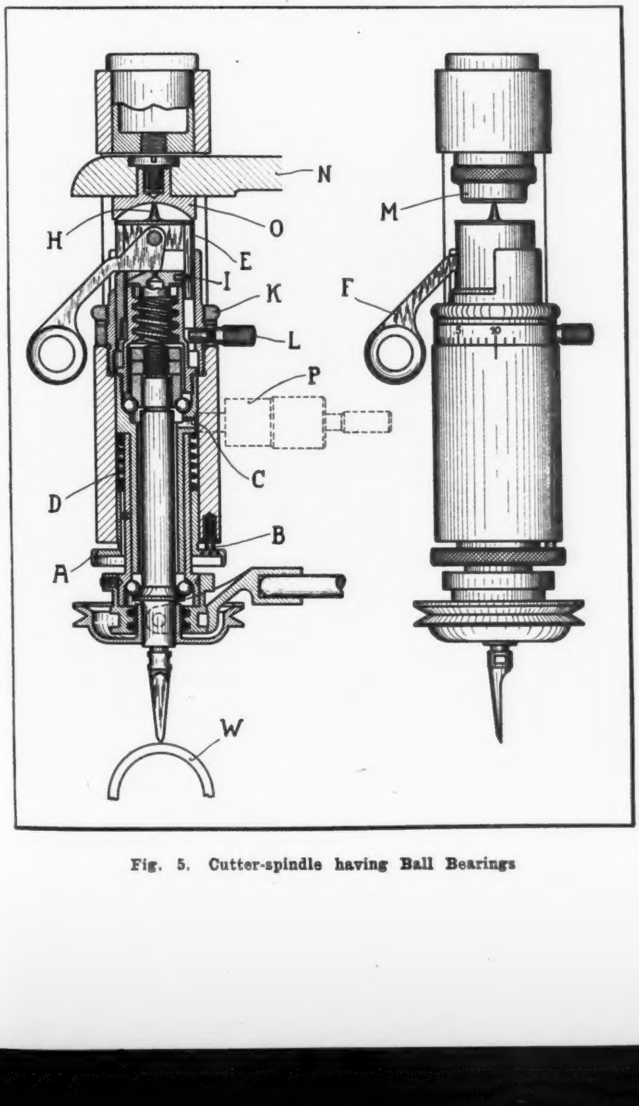


Fig. 5. Cutter-spindle having Ball Bearings

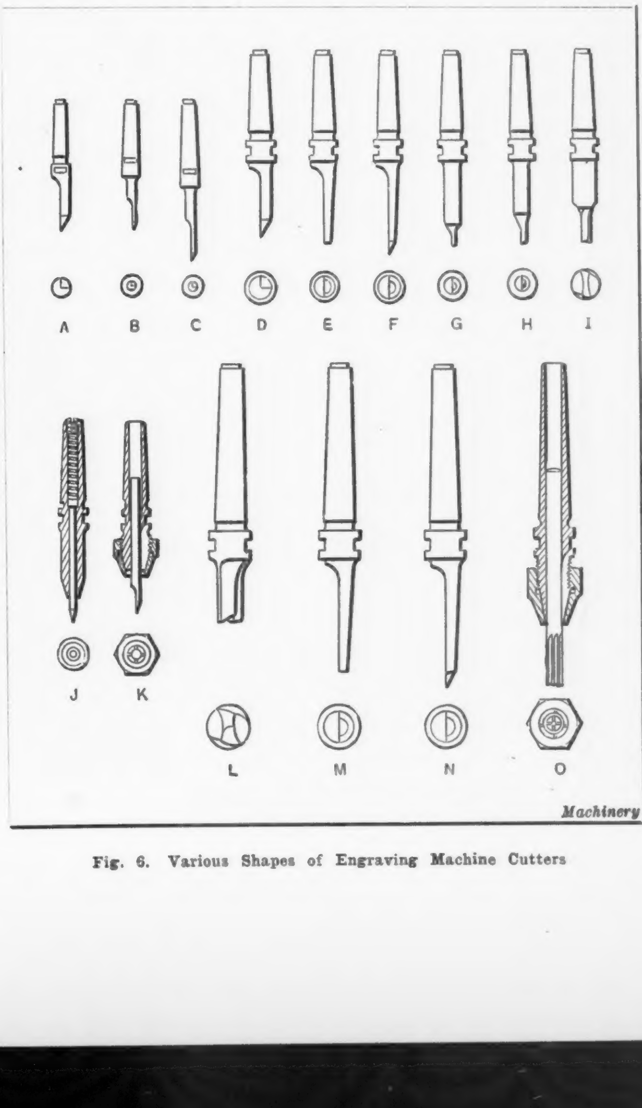


Fig. 6. Various Shapes of Engraving Machine Cutters

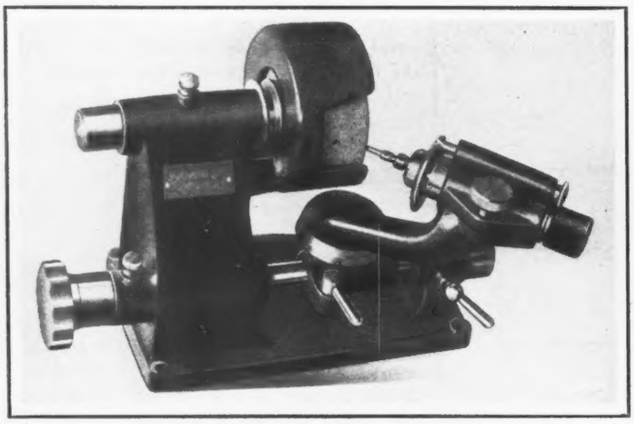


Fig. 7. Machine for sharpening Engraving Cutters

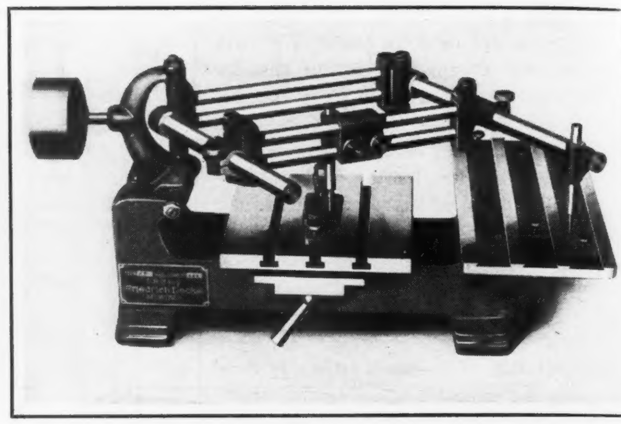


Fig. 8. Machine with Fixed or Non-rotating Cutter

lever to the position shown in the illustration, a cam-like projection quickly depresses the bearing, which is held in contact with the lever by a spring *D*. By turning the lever *F* sidewise, a pin *I* in bushing *E* causes a relative movement in the screw connection, and a comparatively fine axial adjustment is the result.

To limit the depth of cut, a pin *L* is provided, which serves as a stop for the turning movement of bushing *E*; lever *F* may be adjusted sidewise after loosening nut *K*. Spring *D* rests against a knurled bushing *A*, which is held by a bayonet connection of the screw *B*, so that the bearing may readily be removed by lifting and turning bushing *A*. The parts for the axial adjustment, however, remain in the carrier, because beyond the pin *I*. there is no connection with the bearing.

When engraving on flat surfaces, the spring pressure is transmitted by a point *H* to a counter holder *M* fixed on the carrier. For work on curved or angular surfaces, a curved or formed part *O* is used; this is carried by an arm *N* which is fastened to the frame of the machine. When the form *O* corresponds with the surface of the work *W*, engravings of even depth result without requiring an axial adjustment of the spindle. On account of the deflection of the cutter caused by the unequal action of the working edges of a conical cutter operating on inclined surfaces, this form of cutting tool should only be used for surfaces of a moderate inclination relative to the horizontal plane; as a rule, an angle of 30 degrees should not be exceeded.

Cutters for Engraving

The cutters used in an engraving machine vary in form and shape according to the engraving to be done and the material to be worked upon. They are held either directly in the taper seat of the spindle or with an intermediate socket, or else they are formed of cylindrical pieces of drill rod and held in a special holder.

A variety of cutters is shown in Fig. 6. The cutters *G, H, I*, and *L* are really milling cutters with one or two lips, and are used for heavy cuts in wood or metal. For hair-line engravings, which are used to a large extent in the instrument, optical, watch, and similar industries, the cutters *D* and *F* are preferable. The quarter cutter *D* has the advantage that the central edge has been made to coincide within close limits with the axis of the cutter; therefore it may readily be ground with the required relief, on an ordinary grinding wheel and will still run true. To grind a half-round cutter *F* properly, a special grinding attachment is indispensable, as the position of the point cannot be located correctly otherwise.

To produce the very finest of hair-line engravings where the width cut by the point of the tool should be as small as 0.001 inch, it is necessary to eliminate the small unavoidable inaccuracies due to removing the cutter from its taper seat. To accomplish this, the complete spindle bearing is removed from the carrier, as has been described previously, and is inserted bodily in a holder of the special grinding machine shown in Fig. 7. Suitable graduations facilitate the setting of this holder for producing any desired angle of the conical point. The necessary relief of the cutting edge is ground by bringing the cutter up against the face of a cup-wheel and turning it about its axis; this turning movement is discontinued when the cutting edge is in contact with the wheel but before the surface below this edge has been ground back to a truly circular form. In this way, a slight clearance is provided. A handwheel at the left controls the feed of the cutter toward the grinding wheel. A grinding attachment on the engraving machine itself should not be used because of the grinding dust which will settle on the accurately finished surfaces of the engraving machine.

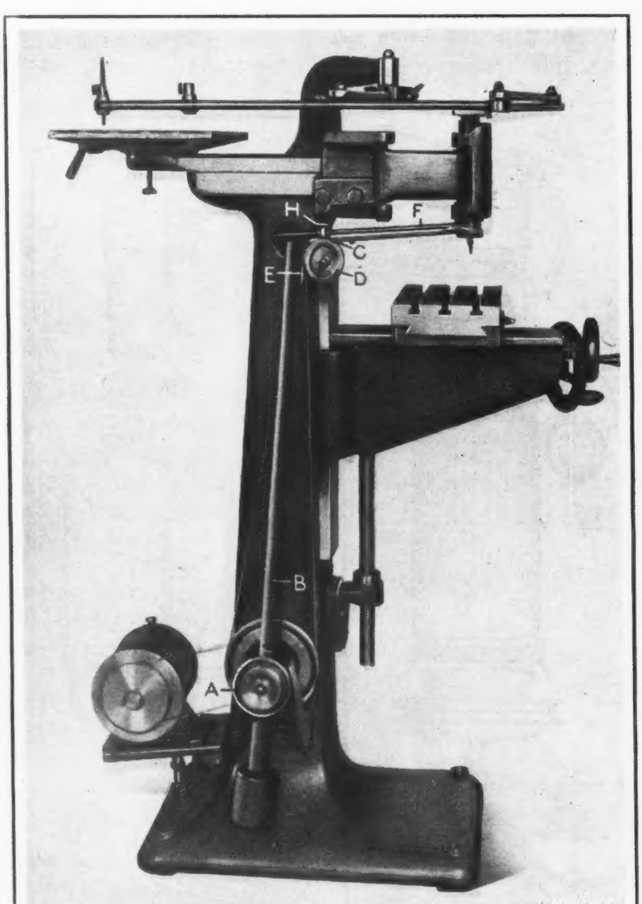


Fig. 9. View showing Arrangement of Drive to Cutter-spindle

Types of Engraving Machines

Engraving machines, like other machine tools, are made in different sizes and types to accommodate various classes of work. The machines referred to in the following, for which a number of patents are pending, are manufactured by the firm of Friedrich Deckel, Munich, Germany.

The plain pantograph shown in Fig. 8 is fitted with a

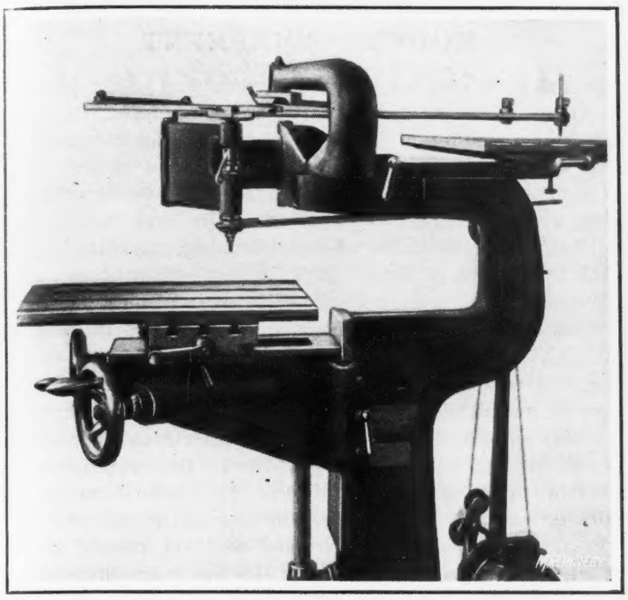


Fig. 10. Machine having Gap Type of Column to accommodate Large Plates

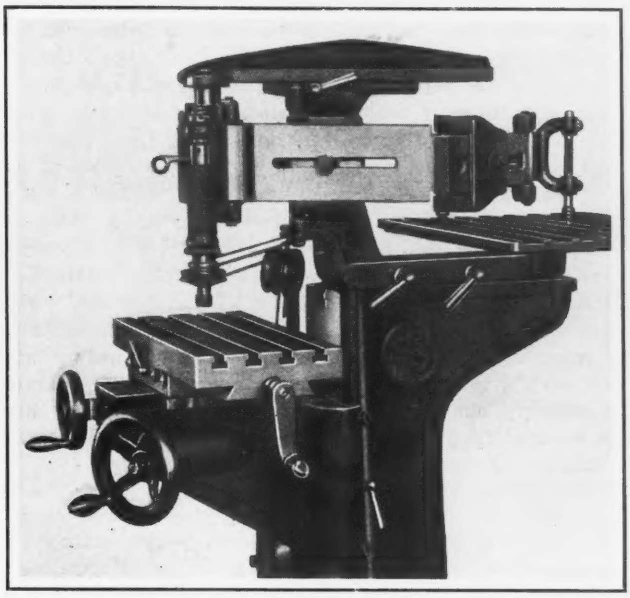


Fig. 11. Machine equipped with Pantograph of Type represented at C, Fig. 1

fixed or non-rotating shaving tool. This machine is intended principally for etching hardened parts, such as gages, tools, etc. A pointed rod *K*, Fig. 6, is guided over a surface previously covered with wax, thus exposing the desired design, which later is etched into the surface by treatment with acids. Having finished a design or any part of it, the etching tool may be removed from the work simply by lifting the tracing stylus, as the pantograph corresponds to the one shown at *B*, Fig. 1. The tracing stylus is fitted with a spring so that it will enter into the grooves of the master before the etching point touches the work; this spring also takes care of small irregularities in the surface of the work.

The bench type of engraving machine shown in Fig. 2 is adapted especially for light cuts on parts of moderate dimensions, such as, for example, most of the work engraved in the optical and instrument trades. The bearing, drive, and axial adjustment of the cutter-spindle, correspond with the construction previously described, while the pantograph is the same as the one shown at *A*, Fig. 1. The machine shown in Fig. 9 differs from the bench engraving machine (Fig. 2) only in having a larger range of action and in being mounted on a solid stand with a heavy work-table, in order to handle to advantage quite large heavy parts.

For engraving large plates, the machine shown in Fig. 10 has been constructed with a frame of gooseneck form. This machine also has a large pantograph, and a long link and carrier for the cutter-spindle bearing, thus permitting a considerable range of action. A large templet holder and

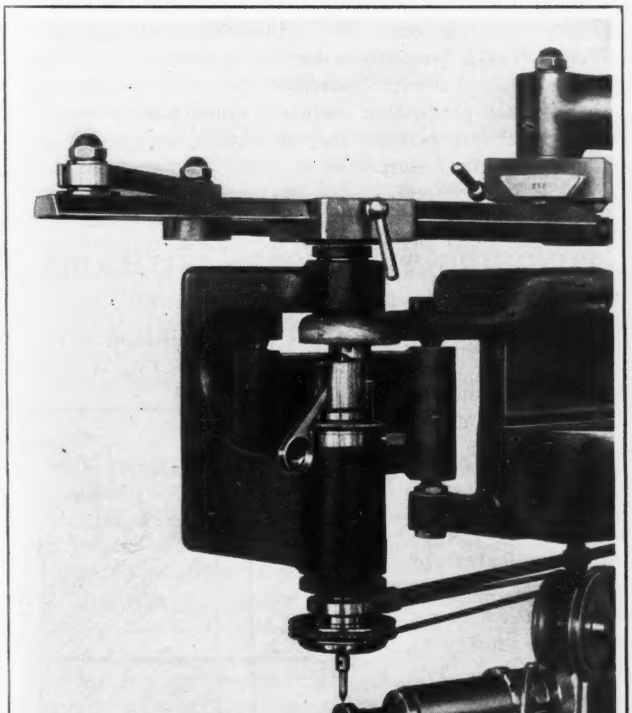


Fig. 12. Attachment for engraving on Cylindrical Surfaces

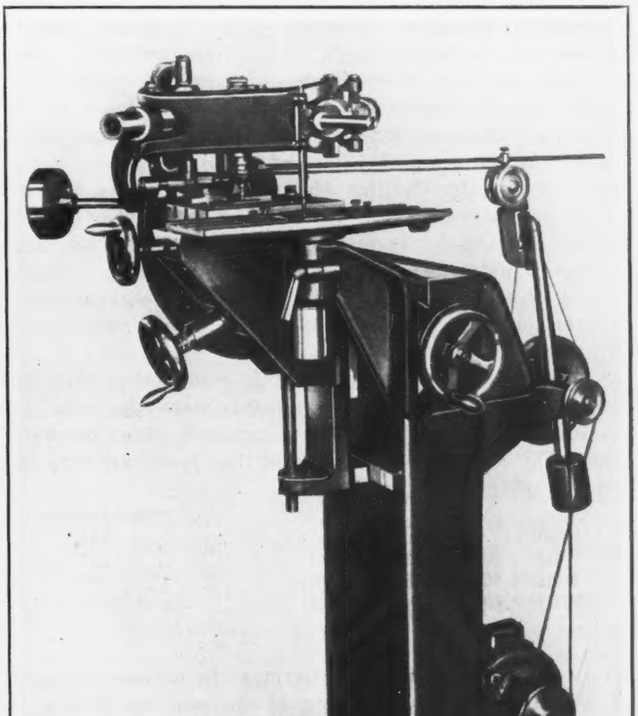


Fig. 13. Type of Pantograph illustrated at B, Fig. 1

an additional work-table allow the full use of the increased range. Otherwise, the machine corresponds fully with the machines shown in Figs. 2 and 9. Fig. 11 shows the application of the pantograph shown at *C*, Fig. 1, on quite a heavy and ruggedly built engraving machine, which is capable of taking regular milling cuts.

All of the machines referred to, with the exception of the plain pantograph type, are constructed to mount, without further change, the attachment shown in Fig. 12. This attachment may be used for engraving on cylindrical surfaces, as shown, or for holding any parts requiring rotation to obtain different working positions. A pantograph corresponding to type *B*, Fig. 1, is shown in Fig. 13 applied to an engraving machine adapted for extremely heavy cuts. With such a pantograph, this machine is not only adapted for ordinary engraving and form milling work, but may also be used for reproducing plastic models, in the milling of dies or for similar classes of work.

* * *

NICKEL IN CAST IRON

The use of nickel in cast iron for the cylinder blocks and pistons of automobile engines was first introduced by the Cadillac Motor Car Co. in an effort to improve the quality of these castings and to obtain longer service from them. For the cylinders an iron is used containing from 1.75 to 1.90 per cent silicon, and from 1.50 to 2 per cent nickel. Without the nickel addition, the Brinell hardness would average from 130 to 150; with the addition of nickel, the hardness can be increased to 175 to 200. This increase can, of course, be accomplished by other means, but with increased difficulty in machining. Inasmuch as these difficulties are eliminated by the use of nickel, the experience has been that it is more economical to produce this hardness by the use of nickel than by other means.

From service tests of cylinders, it was found that with the lower hardness, a wear of from 0.0015 to 0.002 inch developed in 20,000 to 25,000 miles, and they then required regrinding. With a Brinell hardness of 175 to 200, however, the cylinders showed a wear of only from 0.00075 to 0.001 inch and did not need regrinding. This decreased wear is due not only to the hardness of the iron, but also to the fine grain and high luster finish which can be produced by the addition of nickel. It has been found that the nickel cast-iron cylinders at 200 Brinell hardness can be machined as easily as the non-nickel cnes at 150 Brinell.

For pistons, the Cadillac Motor Car Co. uses a 2.50 to 2.75 per cent silicon iron with about 1½ per cent of nickel. Without the nickel, the section of ⅛ inch is so thin that the iron would tend, even with this high silicon content, to be hard and mottled. The addition of nickel prevents the formation of any white iron, but produces a fine-grained, readily machinable iron.

In some recent tests carried out in cooperation with another motor car manufacturer, cylinders were cast with the regular mixture, to which various amounts of nickel were added. The Brinell hardness values on these cylinders indicate the effect of nickel:

	Brinell Hardness
Regular mixture	141
With 0.89 per cent nickel	157
With 1.36 per cent nickel	170
With 1.89 per cent nickel	195

* * *

The ammunition left by the Germans in northern France and Belgium at the termination of the war has been successfully disposed of. During the last two years some 14,000 tons of German ammunition of a very dangerous character has been brought to the coast and dumped in the ocean about 2½ miles from the shore, without any accident having occurred from explosions, either during the transportation or dumping operations.

SAVING MONEY BY INSTALLING MODERN EQUIPMENT

Staged tests on machine tool equipment often are not conclusive, because the conditions surrounding the tests may be quite different from those under which the machine must operate in the shop. For this reason a record of the performance of a machine tool in the customer's shop has much greater conclusive value than any other tests. One well-known manufacturer of machine tools, appreciating the value of reports of actual performance, recently employed an outside investigating engineer to visit a plant in which a machine had been installed and report on the results obtained.

In this case the report related to the performance of a lathe of recent design, having strength and rigidity considerably in excess of the machines formerly employed. The specific savings estimated to be due to the installation of the new machine are as follows: The annual saving in depreciation is $80; this saving is due to the fact that the lathe is heavier and stronger, and for that reason can be expected with certainty to have a life five years longer than the machines used in the past; $40 a year is saved through decreased need for repairs; the work is performed faster on the newer and heavier machine, and a saving of $700 a year is obtainable in this way. The total saving, therefore, is estimated at $820 per year. As the machine costs $2500 to install, it pays for itself in approximately three years. The figures obtained by the investigating engineer were not based alone upon his own judgment, but were concurred in by the shop superintendent, over his signature.

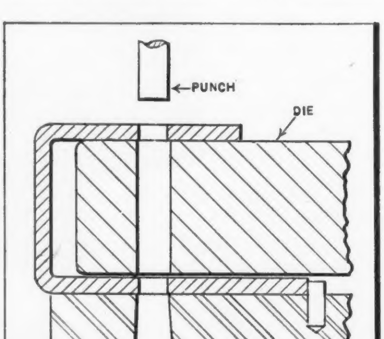
Incidentally, the investigation brought to light the kind of service that is now obtainable from some machine tool builders. When the lathe was unloaded, it was, through carelessness, allowed to tip over, breaking a few parts. Within thirty hours replacement parts had been received by express from the manufacturer, who is located nearly 300 miles from the customer's plant.

If users of machine tools generally would carefully investigate the possibilities of savings by the employment of the newer improved equipment now available on the market, they would in many cases immediately discontinue the use of their old, partially worn-out equipment. It is quite safe to say there are thousands of factories throughout the country whose production costs are much higher than they should be, simply because they are using antiquated methods and machine equipment in their manufacturing processes.

* * *

PUNCHING TWO HOLES WITH ONE PUNCH

The accompanying diagrammatical illustration shows a method used by the Worcester Pressed Steel Co., Worcester, Mass., for punching two holes simultaneously through a bent steel stamping with one punch. The arrangement is quite clearly indicated by the illustration. It is evident, of course, that the punching from the first hole proceeds ahead of the punch down toward the second flange, where it acts as the punch for punching the second hole directly under the first.



Punching Two Holes simultaneously with One Punch

Considerations in Friction Clutch Design

By ALBERT CLEGG

THE diversified use to which friction clutches are put in machine building, together with the differences in the design of these devices, makes the subject interesting to anyone concerned with the design or operation of machinery in general. The many points of difference in friction clutch design are not only in construction details but also in the fundamental design. For example, the questions of the kind of bearing surface and the allowable bearing pressure appear to be capable of as widely differing interpretations as details, the result being that there is necessarily a wide variation in the power-transmitting capacity and in the durability of what are supposed to be equal-capacity clutches of different makes. As applied on machine tools, friction clutches, with the possible exception of countershaft clutches, are usually of such small dimensions that they are subjected to comparatively heavy duty.

Factors Involved in Designing Friction Clutches

Briefly, the problem of friction clutch design is to produce a couple of surfaces which can be squeezed together to connect a non-rotating element to one which rotates, the load being gradually picked up without shock at the highest speeds; in addition, the mechanism must be such that it will function for long periods without undue wear. In a multi-plate clutch, there are more than two surfaces, but the same principles apply and similar conditions are obtained. The fundamental problem lies in the squeezing together of the two frictional surfaces, and in the determination of the maximum amount of pressure they will stand per square inch of surface. Upon the accurate determination of the latter factor depends the economic design of friction clutches. The allowable unit bearing pressure on friction surfaces is difficult to fix accurately; in present-day practice this value varies from 50 to 500 pounds per square inch, and it is by no means certain that even these limits are not exceeded.

Unfortunately the problem is complicated by many other considerations, and one cannot say that a unit bearing pressure of a certain number of pounds per square inch will be suitable under every condition. The speed of the friction surfaces and the inertia of the parts controlled and driven by the clutch are factors that must be taken into account. Obviously, the duty imposed on a clutch driving a shaft weighing only a few pounds and running at two or three revolutions per minute will be much less than that on a similar clutch running at several hundred revolutions per minute and possibly weighing two or three hundred pounds.

Overcoming the inertia of the parts to be set in motion is, in many cases, by far the heaviest work the clutch has to do, because, during the time the driven parts are attaining the speed of the initial drive, the clutch surfaces are necessarily slipping or sliding on each other. Needless to say, it is this slipping under the full pressure of the squeezing elements that is the principal destructive agent in the life of the clutch. There is little or no trouble when the two friction surfaces are in intimate contact and transmit the full load without slipping, as no wear can take place under this condition. Furthermore, when the clutch has once taken hold, there is not much possibility of slippage except under a heavy overload. This is due to the fact that static friction is greater than running friction.

The inevitable conclusion, then, is that the initial problems of friction clutch design are more or less related to those met with in designing running bearings. At the moment of engagement, the two surfaces of a friction clutch, because of sliding on each other, act in exactly the same way, and are controlled to a certain extent by the same laws, as a shaft running in a bearing. The longer the period that such sliding continues, the closer the relationship. With metal-to-metal clutches, the analogy between clutches and journal bearings is closer than with fabric-lined clutches.

Allowable Bearing Pressures

Professor Lineham, in his text-book on mechanical engineering, gives the following values for allowable bearing pressures, in pounds per square inch, to suit various conditions: Very slow speeds, 3000 pounds; cross-head journals, 1200 pounds; crankpins, 800 pounds, and for slow engines, 900 pounds; marine crankpins, 400 pounds; marine crankshaft bearings, 600 pounds; railway journals, 300 pounds; propeller thrust blocks, 50 to 70 pounds; and lineshafts with cast-iron bearings, 15 pounds.

These values, ranging all the way from 15 to 3000 pounds per square inch, do not appear to be of much help in determining upon suitable unit bearing pressures for friction clutches. One thing, however, is indicated, and that is the greatly increased load-carrying capacity of slow-running bearings as compared with fast-running ones; and this fact should be borne in mind when designing a friction clutch.

It must also be remembered that the values relate to bearings that are in continuous operation for long periods with the usual provision for lubrication. In the case of friction clutches, however, the actual sliding of the surfaces on each other is only momentary—a question of seconds or perhaps only a fraction of a second for each engagement. It is therefore reasonable to assume a higher value for the allowable unit bearing pressure of a friction clutch than for an analogous bearing. The writer is strongly of the opinion that unit bearing pressures of friction clutches are generally taken much lower than is necessary. Quite a common value for this factor is 50 pounds per square inch, yet according to the foregoing values, railway journals, which run at high speeds for long periods may be designed on a basis of 300 pounds per square inch of bearing area. It should therefore be possible to assume some such figure for a friction clutch in which the actual sliding is limited to a period of not more than two or three minutes a day in the aggregate, even with several hundred engagements.

The lubrication of the friction surfaces is an important factor in determining the load-carrying capacity. If the surfaces are well lubricated, there will be little wear even after prolonged use, but should the surfaces become dry, which is almost an impossibility, a seizure would be likely to occur, or in any case, rapid wear. Even the most indifferently lubricated clutch will receive a certain amount of oil from the running element as soon as it is disengaged, because centrifugal force will tend to fling any oil overflow from the bearing to the friction surfaces. Sufficient oil on these surfaces to take care of the momentary slip of engagement, is all that is required, and if this is present, the clutch will continue to give good service, with little wear, for a long period of time.

The material of which the friction surfaces are composed is another element that should be considered. There are innumerable combinations, such as leather to cast iron, cast iron to cast iron, wood to cast iron, steel to bronze, cast iron to bronze, and hardened steel to hardened steel. For light and medium service, cast iron to cast iron will give the best results, and with anything like correct propor-

tioning of the clutch surfaces, this metal will give long service with little wear. In the remainder of this article both friction surfaces will be considered as being cast iron unless it is specifically stated otherwise. With cast-iron friction surfaces, average lubrication, normal loads while being engaged, moderately frequent engagement, and average conditions generally, the writer would suggest the following empirical formula as a guide:

$$\text{Allowable unit bearing pressure} = \frac{300 \times 700}{V + 200}$$

in which V represents the velocity of the friction surfaces in feet per minute. The addition of the constant 200 allows for the unit pressure being reduced somewhat in proportion as the velocity increases.

Calculating the Horsepower

The horsepower of the clutch can be found from the formula:

$$\text{H.P.} = \frac{300 \times 700 \times f \times D \times W \times V \times 22}{(V + 200) \times 33{,}000 \times 7} = \frac{20fDWV}{V + 200}$$

in which V = velocity of the friction surfaces, in feet per minute;
D = mean diameter of the friction surfaces;
W = width of the friction surfaces; and
f = coefficient of friction (about 0.15 for average conditions).

If this formula is tried out on existing successful examples, it will be found to give fairly satisfactory and consistent results. As an example of its use, find the allowable bearing pressure and horsepower of a conical clutch having a normal diameter of 4 inches, a face width of 1 inch, and running at a speed of 500 revolutions per minute. For the sake of easy calculation, take the circumference as one foot, which will be near enough for the purpose. Then,

$$\text{Allowable bearing pressure} = \frac{300 \times 700}{500 + 200} = 300 \text{ pounds}$$

per square inch

$$\text{H.P.} = \frac{0.15 \times 4 \times 1 \times 500 \times 20}{500 + 200} = \frac{60}{7} \text{ or } 8.57$$

Types of Friction Clutches

There are several separate and distinct types of friction clutches, including (1) expanding or contracting ring clutches; (2) conical clutches; (3) single-plate clutches; (4) coil clutches and (5) multiple-plate clutches. The first of these consists of some form of a flexible ring which is expanded or contracted, as the case may be, with considerable pressure against the mating portion of the clutch. One of the difficulties met with in the operation of this type of clutch is the uneven distribution of the pressure on the friction surfaces, which often results in undue wear on certain comparatively small areas.

This trouble is due to the lack of flexibility in the expanding or contracting ring. However, if the ring is too flexible there is danger of its expanding by centrifugal force and coming into operation to some extent when it should be completely out of engagement. On the other hand, if the ring is made stiffer to resist this tendency, there is a risk that the bulk of the expanding pressure will be concentrated at two or three comparatively small sections of the friction surface. In such a case the bearing pressure, which is assumed to be distributed over the entire friction surface, will be considerably increased in pounds per square inch, owing to the fact that the total pressure is actually carried by only a fraction of the surface. The best way to overcome the difficulty is to provide some form of spring closing arrangement which will contract the ring and keep it contracted except when the expanding mechanism is brought into operation. If this plan is adopted, there is a much better chance of allowing enough flexibility in the ring to insure a comparatively even pressure over the whole wearing surface.

The second or conical type of clutch generally takes up more room axially, and is adjusted for wear in this direction, while the ring clutch does not take up quite so much space lengthwise, and its mechanism for adjustment is usually more self-contained and better fitted to the requirements of all-geared drives. However, with the conical clutch there is much less difficulty in insuring that the whole of the friction surfaces will take an equal share of the load. In addition, when a conical clutch is out of engagement, there is not the slightest possibility of its being influenced by centrifugal force, because the two friction surfaces are definitely clear of each other; furthermore, the parts of the clutch, and particularly the friction elements, are usually sturdier in construction and less likely to break. Also, an adjustment can generally be made much more quickly with conical clutches.

Single-plate, Coil, and Double-plate Clutches

The single-plate type of clutch is really closely related to the conical type, the main point of difference being that, whereas in the latter the friction surfaces are conical so as to multiply the axial pressure by which they are held together, in the former they are at right angles to the axis, and therefore subjected to only the direct and non-multiplying pressure of the closing mechanism.

Coil clutches are a comparatively recent development said to have been inspired by an observation of the action of the ordinary power-driven capstan. It is common knowledge that a comparatively small pull on the end of a rope wound several times around the drum of a capstan will develop sufficient friction to hold an enormous load suspended at the other end. The coil clutch is the same in principle, a comparatively flexible, helical coil encircling one of the friction surfaces (the inside of the coil being the other) and so arranged that one end may be turned in relation to the other so as to close the coil on the driving portion.

The clamping effort is applied in such a way that as soon as the first section of the coil makes contact with the driving portion, the friction developed helps to clamp the remaining sections with a progressively increasing pressure. Coil clutches are not very suitable for ordinary machine tool use, as they are usually too bulky, but they are peculiarly adapted for the transmission of heavy loads, because of the ease with which the wearing surfaces can be increased in area to meet the most exacting requirements.

The multi-plate type of clutch is one of the most ingenious friction clutches. For compactness, load-carrying capacity, durability, and adaptability to widely varying requirements, the multi-plate clutch is unexcelled. It is in use both as a brake and as a clutch for the heaviest duty, while it can also be found in light service applications. As a comparison, it may be mentioned that bicycles, motorcycles, and automobiles are equipped with it.

One feature of the multi-plate clutch is that, like the coil clutch, it is a simple matter to increase the load-carrying capacity to almost any extent by the mere incorporation of a few more plates. It has been mentioned that the single-plate clutch is one in which the load is carried by a single surface which is squeezed, by axial pressure, against a mating surface. The multi-plate clutch is simply an extension of the same idea, one axial pressure being applied to take effect on several single plates. Other things being equal, this design will give several times the load-carrying capacity of the single-plate type with the same operative effort and with comparatively little increase in size.

There are further sub-divisions into which friction clutches could be classified, as for instance, magnetic and pneumatic clutches; cork-covered, fabric, leather-lined, and many other variations, which largely concern the method of operation or some particular detail of construction. Specific designs of clutches will be considered in subsequent articles.

A Practical Drafting-room System

A Description of Methods Successfully Applied in the Management of a Drafting Room—Second of Two Articles

By I. BERNARD BLACK

PART of a system of supervision and administration for a drafting department was described in the first article on this subject, published in April MACHINERY. The present article will explain the making and recording of revisions on drawings and other points of interest to the draftsman. In the first place, no addition, erasure, or alteration of the most minute detail can be made on an approved tracing without the authority of the chief engineer, who is superior to the chief draftsman. When it becomes necessary to revise a tracing, an "order of revision" is prepared at the direction of an executive on the form shown in Fig. 1. This order enumerates the changes necessary, correspondence of the engineering division relating to the proposed changes, etc.

After the order for revision has been authorized by the chief engineer, the draftsman must first make sure that a serviceable print and photographic print are on file of the part in its present state. As an indication that such prints are on hand, the file clerk is required to place his initials on the order. Only one order of revision is required when more than one drawing of the same class and division are to be revised, but should the contemplated change involve more than one class and division, a separate order is necessary for each.

REVISE DRAWINGS OF

FOR .... MODEL OF

TO SHOW

CORRESPONDENCE

REVISION ORDERED .... 19 CHIEF DRAFTSMAN.

REMARKS

REVISION ORDERED BY

DRAWINGS TO BE ALTERED

Class .... Division .... Drawings									
File prints O. K. for last prior date									
Draftsman									
Tracing checked by order and text									
Chief Eng's. O. K.									
Prints ordered for file and distribution, Order No.									
Texts of revision and large prints mailed									
Photo prints on file for last prior date									
Photo prints, Order No.									
Photo prints mailed									
Large and Photo prints and text of revision in files									
Revision dated									
Last prior date									

Fig. 1. Form on which is given the Order to revise Tracings and Information Necessary in Connection with the Revision

The revision of a tracing is limited to the parts ordered changed and those immediately affected thereby. When a revision is made, a new revision date and number must always be added in the spaces provided for them in the title rectangle of the drawing, which was illustrated in the previous installment of this article. When more than one drawing is affected by the same revision order, all drawings must be given the same revision date, and for this reason all contemplated revisions on any one class and division of drawings should be made at the same time whenever practicable. Every change made on a tracing, whatever its nature, is recorded by the draftsman making the change, upon a "text of revision" form, such as shown filled out in Fig. 2. When a detail is no longer used, it is simply crossed off with lines made on the reverse or smooth side of the tracing.

Any revision involving changes in drawing numbers or which otherwise affects the records of the filing room or the distribution of prints, must be referred to the file clerk for his information. When the changes are extensive, a new tracing showing the same drawing in the revised form is made to supersede the original tracing, in which case the new tracing is given the same drawing number, the original date, and the last revision date of the old tracing, and also an additional revision date to indicate the changes embodied in the new tracing. The new tracing then takes the place of the old one in the set of drawings for the particular unit or machine, and the original tracing is marked as being superseded, the file number being prefixed by the letter S. When a tracing becomes obsolete without being superseded, it is simply marked "obsolete" in large letters in the lower right-hand corner.

When a new tracing is given a different drawing number from the old, as is the case when a tracing supersedes two old tracings, the original tracings are marked as being superseded, but the prefix S is omitted from the file number. An additional "text of revision" is required, the one referring to the new tracing stating that both old tracings are superseded. It may sometimes happen that one old tracing is superseded by two or more new ones, all of which will bear the same class and division numbers as the old, and one of them the same drawing number, while the others are given new drawing numbers. A note is placed on the old tracing to show that it is superseded by two or more new tracings. One text of revision is made to cover the old and new tracing of the same number, and other texts are required for the tracings given the new drawing numbers, in order to show their connection with the old tracing.

TEXT OF REVISION OF DRAWING NO. .... DATE OF REVISION 2-4-24

Class 2. — Division 1. — Drawing 4.
Section 1:
Motor Frame—Lifting lug and bracket added.

Top View—
Outer distance of bolt holes relocated to scale.
Dimensions—1.5 changed to 1.65 and 0.45 to 0.5.

Title: 60 Cycle, 3 phase added.

Fig. 2. Sheet on which are written All Changes made on a Drawing

In certain cases a drawing in one class and division may be superseded by a drawing in another class and division, and then the superseding drawing, if new, is given the original date of the old tracing and a revision date and number, and if old, simply a revision date. The superseded tracing is so marked, and a file number added without the prefix S. Two orders for revision are required, whether the superseding tracing is old or new, but if new, the order is simply a memorandum to connect the drawings one with the other and requires no authorization. When it becomes necessary to change the classification of a drawing from one class and division to another, two orders for revision are required, one for each class and division. The text of revision relating to the original numbers merely shows the change in classification, while that relating to the new numbers may show other changes in addition to that of classification.

When changes on drawings are completed, the drawings and text of revision are checked with the orders for the execution of the work, as well as with each other, by the chief draftsman or another draftsman detailed to do the work. The drawings and texts are then submitted to the chief engineer, who approves the work on each drawing by putting his initials in the space provided for that purpose on the order for revision.

Ordering Prints from Tracings

A draftsman or other person known as the "print inspector" is detailed to order, check, and inspect all prints of any nature, multiple copies of texts of revision, etc. Immediately upon the completion and approval of a tracing or revision, prints, and in most cases photographic prints, are ordered for filing purposes and for use by persons requiring them. Prints cannot be ordered from any changed tracing not bearing a revision date or the initial of the clerk in charge of the files, until a distribution card has been verified by this clerk. Orders for prints are not executed in the blueprint room unless they are given to the print inspector made out on the regular form shown in Fig. 3. Either the word "blue" or "brown" is inserted after the word "issue" in the space provided. An order for a brown negative print required for reproducing positives is indicated by adding the letter N after "brown."

The print inspector is required to keep the stubs of print-order books properly filled out to show the state of progress of all orders. He also keeps a record of the number of each print order, the class and division of drawings covered by the order, the date of the order, the dates upon which it was sent to and returned from the print room, and the number of prints called for. Orders for prints are sent daily to the print room, and special rush orders must be initialed by the chief draftsman. Every morning the print inspector makes out a report on which is stated the amount of work on hand and the number of prints delivered on the preceding day.

Prints are never permitted to be made from a tracing that has been only partly revised except when urgently needed. Then a report is made to the chief engineer, and instructions may be given by him for the termination of the revision in that state and the addition of a revision date. In such a case the alteration in progress is subsequently completed, and another revision date added. Immediately after the order for a print of a changed tracing has been completed, and the number of the print order has been entered on the order of revision, the draftsman's text of revision is delivered by the print inspector to a stenographer to have multiple copies made.

The print inspector is held responsible for the cleanliness of tracings. However, he is not permitted to remove notes without authority, as a record is kept of all essential memoranda made in that way. A careful inspection is also required of all prints to detect evidence of insufficient washing and insure clearness and legibility of all details and dimensions. Prints must be of sufficient strength to be easily read, and in the case of brown prints must be strong enough so that other prints can be made through them. Changes on prints made from approved prints and intended for filing or distribution are never allowed to be made except by the permission of the chief draftsman. Factory file prints cannot be changed in this way, but additional dimensions or notes may be added to facilitate the work.

Duties of the File Clerk

The files are in charge of a clerk who files drawings, prints, and texts of revision, keeps all records pertaining to drawings and distribution cards, and approves orders for revision. He is assisted by the print inspector and a messenger, and has general supervision over the former and all employes of the print room. It is one of the duties of the file clerk to see that the work of the print inspector and the inspecting room is carried on in a systematic manner. Business communications between employes under him must pass through his hands. The file clerk also makes out requisitions for supplies for the drafting and printing rooms and has charge of the custody and distribution of the supplies. Proper records must be made before new

ENGINEERING DIVISION DATE ....

PLEASE ISSUE .... PRINTS .... OF DRAWING ....

DATED / REVISED .... TO THE ....

FOR ....

.... FACTORY

THE ABOVE PRINTS RECEIVED .... AND PLACED IN

SHEET METAL MOUNTS. OLD PRINTS RETURNED HEREWITH.

.... FACTORY

RETURN THIS CARD TO THE DRAFTING ROOM.

Fig 3. Card on which Orders for Prints are made out

PATTERN NO.	NAME OF PATTERN / USED FOR		
SERIAL NO	WOOD / METAL	LOOSE PCS.	CORE BOXES
LOCATION	SECTION	SHELF NO.	CASTING WT

SENT TO	DATE	IN	SENT TO	DATE	IN

Fig. 4. Form for keeping a Record of All Patterns

drawings or tracings are permanently filed, and changes in records must always be made immediately upon notification.

Whenever a new tracing is turned over to the file clerk, he obtains from the chief draftsman a list of the persons to whom prints are to be distributed. Fig. 4 shows a form that is kept by the file clerk to keep track of patterns inside and outside the plant. This record is kept up by cooperation with a file clerk in the pattern shop, and eliminates the necessity of the drafting department communicating with the pattern shop each time it is desired to change the construction of a pattern, in order to ascertain where the pattern is. A report is made to the file clerk whenever the stock of blue or brown print paper or cloth or photostat paper is so nearly exhausted as to require an additional supply within thirty days. When a delivery of paper or cloth is made, one or more rolls are tested by making a graduated exposure.

Brown Cloth Prints Used for Permanent Records

Upon the completion or revision of a tracing, a brown cloth print is made to be filed as a permanent record, and such prints are never allowed to be removed from the drafting-room. They are filed serially in a "current" file until superseded. When they are taken from the current file, they are given a file number with a colored pencil to show their sequence in the series of prints of successive states of the tracings from which they have been made, and finally placed in a "back" file. All prints are preserved in this back file, because, in many cases, units or machines exist in service which are not altered to conform to the revisions of drawings, and in such cases reference to the back file is often necessary. The texts of revision are filed by divisions in chronological order in books of convenient size, in which the texts are pasted to stubs. On the back of these books are given the class and division numbers, and the dates of the earliest and latest revisions contained in them.

Keeping Records of Notes and Calculations

All notes, calculations, sketches, etc., used in the development of designs, are made on special cross-section paper sheets. The sheets are punched for ready insertion in a loose-leaf binder, in which they are filed in numerical order according to the part or machine. The sheets are divided into sets, each of which pertains to a sub-division of the complete design. Every set is preceded by a title page on which appears the name of the design, the sub-division, the object of the calculation, the number of sheets, the date of the last sheet of the set, the name of the draftsman, and any other data which may be of help at a future time. Calculations that do not apply to the completed design are marked "Not used" with a red pencil, while those that apply to the structure as finally used are marked "Used" in black pencil.

The work of all men is combined upon the completion of each design under the direction of the chief draftsman, and tabulated sheets giving the principal forces, dimensions, and other characteristics are compiled and entered in the book immediately following the index. The sets are numbered consecutively, in the order in which they are filed, and separated by the index sheets.

* * *

"Steinmetz and His Discoverer" is the title of a 24-page booklet just published by Robson & Adee, Schenectady, N. Y. The booklet was written by John T. Broderick, an early associate of Doctor Steinmetz in the General Electric Co., and at present employed there. He is also author of "Pulling Together," a book on industrial relations, containing an introduction by Doctor Steinmetz. Mr. Broderick points to E. Wilbur Rice, Jr., as the discoverer of Steinmetz, and describes their meeting in a Yonkers work-shop thirty years ago. An outline of the growth of the electrical industry in the last twenty years follows, as a prelude to the description of the influence of the two men on electrical progress.

THE BRITISH EMPIRE EXHIBITION

The British Empire Exhibition, which opened at Wembley in April and remains open until October is on a more elaborate scale than any previous exhibition held in England. It is estimated that £10,000,000 will be spent on the enterprise, and arrangements are being made to accommodate about 30,000,000 visitors during the exhibition. The exhibition grounds cover 216 acres, and the most extensive range of exhibits relates to the engineering industries. The Palace of Engineering is probably the largest ferro-concrete building in the world, and has a floor space of 500,000 square feet. Railway tracks in direct communication with the main trunk railways of the country traverse the building from end to end for the purpose of bringing the exhibits to a position where they can be handled by overhead cranes. The total over-all length of the building is 950 feet and the greatest over-all width is 725 feet.

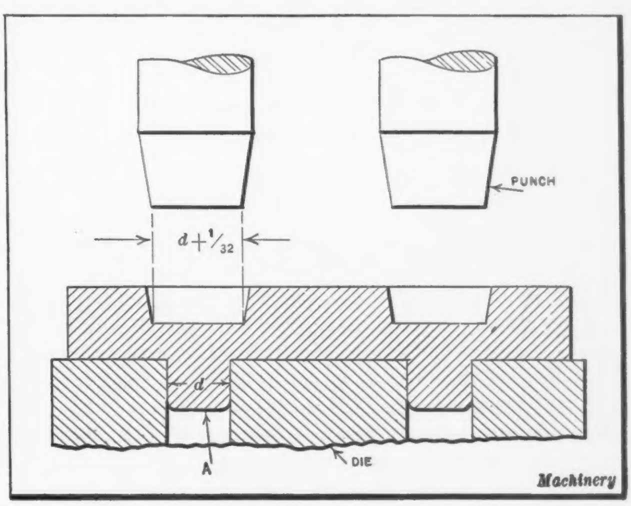
The mechanical engineering section will cover every phase of the manufacturing industries. Incidentally, it may be mentioned, however, that exhibits of machine tools are likely to be few and far between. This is due to the fact that the association of machine tool builders in Great Britain is holding its own exhibition at Olympia in September, and as the latter exhibition is fully representative of the machine tool industry of the country, there is no purpose in showing machines at two exhibitions simultaneously.

The Palace of Industry is only slightly smaller than the Palace of Engineering, and will house the products of industries that do not come under the engineering category. The largest individual exhibit in this section is that of the chemical industry, which will cover 37,500 square feet. All Dominions, Colonies, and Dependencies of Great Britain have their own exhibition buildings which house exhibits of each particular country.

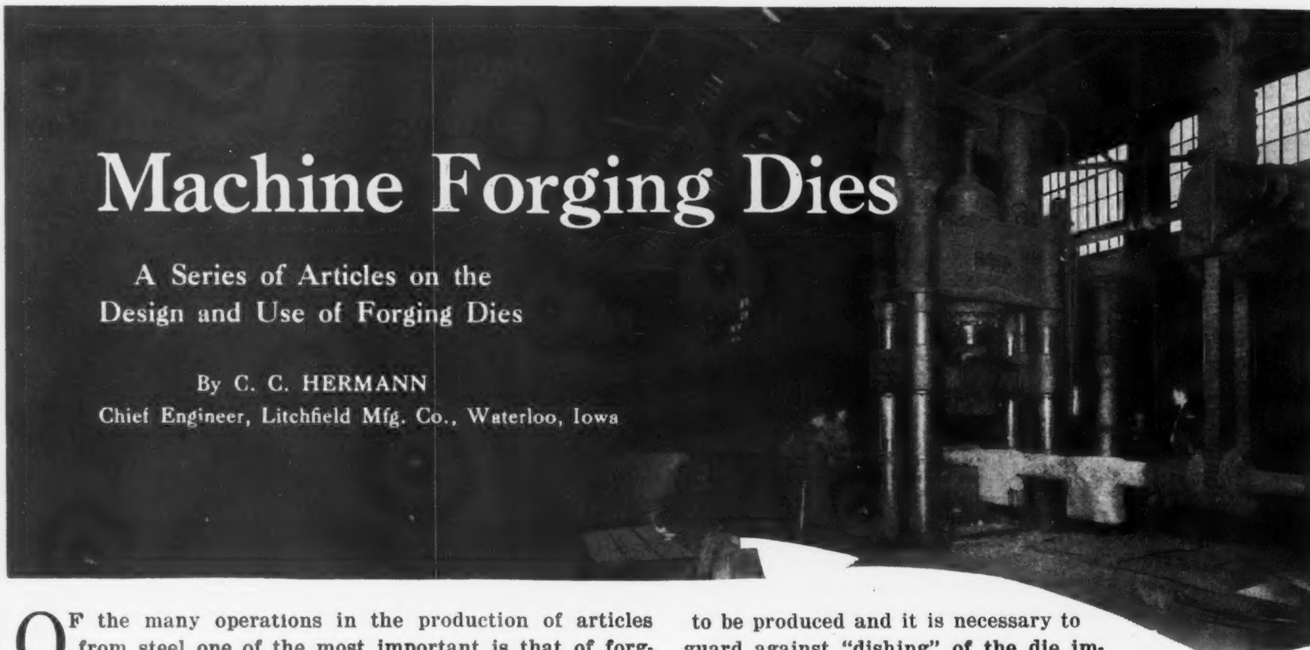
* * *

PRODUCING PARTS HAVING SELF-CONTAINED RIVETS

The accompanying diagrammatical illustration shows a method used at the plant of the Worcester Pressed Steel Co., Worcester, Mass., for producing projections on sheet-metal parts in such a way that the projections may be used as rivets for attaching this part to another metal stamping. As indicated, the punch is pushed about half way through the metal. This causes the metal to flow into the die, thereby producing a projecting rivet as shown at *A*. The punch is slightly tapered and the diameter at theend is about 1/32 inch larger than the diameter of the hole in the die in which the rivet is formed. It will be understood that this difference in diameter prevents the metal from being completely sheared off in the sheet.



Method of producing Projections on Sheet-metal Parts, which may be used as Rivets



Machine Forging Dies

A Series of Articles on the Design and Use of Forging Dies

By C. C. HERMANN
Chief Engineer, Litchfield Mfg. Co., Waterloo, Iowa

OF the many operations in the production of articles from steel one of the most important is that of forging. The steel forging plays a prominent part in machine construction, frequently taking the place of castings, particularly where high tensile strengths are essential. Under certain conditions, the advantages of steel forgings over castings are low cost, greater strength, ductility, and greater accuracy of form. Low cost of manufacture is essential to meet competition, and strength is necessary to provide reasonable life and safety without excess weight. Machine forging operations may be classified as drop-forging, heading or upsetting, and bending. These operations may be further classified as hot and cold forging.

Forgings are generally made of low-carbon steels, but alloy steels, wrought iron, tool steel, copper, bronze, and other metals are also used. Low-carbon steels, certain brass alloys, and aluminum can be pressed, rolled, or punched cold; however, aluminum is generally drop-forged at a temperature slightly below a dull red, zinc is most easily worked at temperatures ranging between 300 and 400 degrees F., while ordinary metals can be worked from atmospheric temperatures up to 2000 degrees F. It is therefore readily understood that, in its broadest sense, machine forging is the working of metals, either hot or cold, by means of a machine which causes the metals to flow into various shapes.

Materials from which Forging Dies are Made

In cases where a forging die is required to produce but a comparatively small quantity of pieces, a close-grained iron casting is used, the die being cast in a sand mold. The impression or face of the die is cast direct to form and later finished by filing, chipping, and scraping. Wherever possible, the die face is used as it comes from the foundry, thereby retaining the sand chilled surface which has better wearing qualities than machined surfaces. In many cases, where longer life of the die is desirable, and it is possible to do so, the face is chilled in the mold by the use of an iron chill.

Steel castings are extensively used for forging dies. These dies are often made from a pattern of the desired shape having a finish allowance, but where a large quantity of duplicate parts warrants it, the dies are cast with a flat face and the desired forms cut in by milling, chipping, and scraping. Die-sinking machines are used for this finishing; however, shapers, milling and drilling machines and lathes are capable of performing a good many of the steps. A cherrying attachment is a valuable appliance of the die-sinking machine, as by its use the cost of the operation may be decreased to a considerable extent.

Open-hearth carbon steel of from 0.60 to 0.80 per cent carbon is also used extensively for forging dies, principally for deep-forging work when a great quantity of pieces are to be produced and it is necessary to guard against "dishing" of the die impression. This material is also preferred for dies that must produce deep narrow recesses in the work, the necessary thin projections on the surface being readily broken off when the die is made from other materials. Carbon steel dies may be hardened by heating to a cherry red, and immersing them in a bath of water or brine. They should then be drawn to reduce the brittleness and to relieve internal stresses. Often it is preferable to use an 0.80 per cent carbon steel and eliminate the hardening, so as to avoid possible loss of the die by hardening checks. Thin projections are also easily broken off in the hardening process, so that considerable care and judgment must be exercised in the selection of materials and their treatment.

Considerations before Making a Die

Ordinarily the diemaker is furnished with a drawing of the proposed die, on which the procedure of making the die and the selection of the material are detailed by the engineering department. In many small plants, however, where an engineering department is not maintained, a sample forging, a model of the finished part, or a rough sketch only is supplied, and the details of selecting the material and making the die are left to the judgment of the diemaker. In either case, some one must assume the responsibility of the work, do the planning, and determine the number of operations necessary to produce the die.

In general, some of the points that must be decided are as follows: (1) How many roughing and finishing impressions will be required in forging the part, and should the finishing impression be made in a separate set of dies? (2) On what type of machine is the work to be performed? (This point must be considered in order that the die may be made to fit the machine.) (3) In what direction should the impression of the die face? (On this rests the decision as to the best form of breakdown.) (4) If a deep forging, shall the work be trimmed hot or cold? (5) What material should be used for the die parts? (6) What finishing operations are subsequently given to the work? (The proper allowances for shrinkage and finishing depend upon these.)

Points on the Design

To illustrate the fundamental principles of design with reference to drop-forging dies, one of the simplest forms of this type of die is shown at *X* in the illustration. This consists of the upper die part *A* and the lower die part *B*, the impressions being shown by dotted lines. It is common practice to place the deeper impression in the upper die, as it is found that the metal more nearly fills all parts of the impression when so made. The joint line of the die is at *C*, and while in this example the line is straight, there

are many cases where the joint line must consist of two or more straight lines that lie at an angle to each other and sometimes have a curve to join them; however, the joint line depends on the work.

It is essential that the dies be so designed that no side thrust will come on the machine. This is generally accomplished by one of three methods: (1) By choosing an angle for the position of the work in the die that will compensate for any side thrust. (2) By using a straight-line joint horizontal to the bed of the machine. (3) By adding thrust lugs on the die at such an angle that all side-thrust will be removed from the guides of the machine.

Example *X* shows how the thrust is balanced by the use of a straight-line joint, and example *Y* by laying the work at the proper angle. In the latter case, the work, as shown by the dotted lines, consists of a round-section piece formed to the angle shown. The joint line consists of the straight lines *D* and *E* and the slightly curved line *F*. The thrust at section *G* of the upper die is offset by the thrust at *H*, and the amount in either direction may be varied by changing the angle of the die faces. Side *H* has the larger area; therefore, if the angles between the dot-and-dash horizontal line and the impressions in the die were equal, the thrust would be away from side *H*. To equalize the thrust, the impression along side *H* is at a smaller angle from the vertical than the impression along side *G*.

The third method of balancing thrust is illustrated by the view at *Z*. Here the work again consists of a round-section piece formed to the shape shown by the dotted lines. Should the joint line continue to the right-hand edge of the die, as indicated by the dotted line *J*, the thrust due to the vertical joint line would be toward the right. To equalize the thrust, the die is made with part *K* on the lower die fitting into a recess in the upper die.

Shanks *L* of drop-forge dies are standard, so that dies can be made up from bars of steel machined entirely on the back and then cut into the desired lengths. For this purpose, steel bars 8 feet in length and of the proper cross-sectional dimensions are usually obtained direct from mills or warehouse stocks. These bars are first planed along the top surface and along the side that will form the left-hand side of the finished die. The bar is then turned over and the shank or dovetail planed to the proper angles and height. After cutting the bar into blocks of the required length, the front of the die is planed for a distance of about 2 inches to facilitate laying out the die impressions and lining up the dies on the hammer.

The Fuller, Breakdown, and Roughing and Finishing Impressions

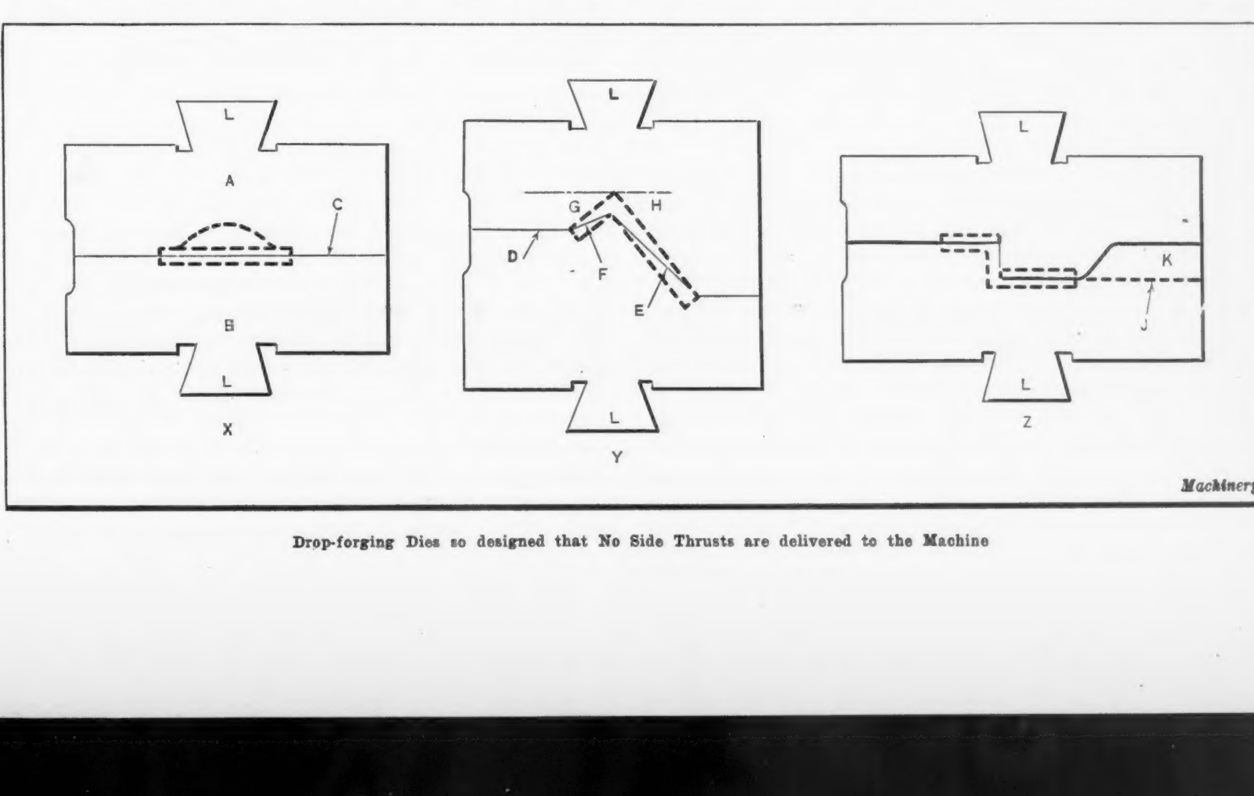
Only occasionally is it possible to form and finish a forging in a single die recess. Ordinarily four die impressions are required, namely, the fuller; the breakdown, edge or side cut, which often takes the form of a bending impression; the roughing impression; and the finishing impression. To these may be added the cut-off, if the work is to be cold-trimmed.

It is often necessary to enlarge or otherwise work the stock in order to make it fill the roughing and finishing impressions, and this is accomplished in the fuller impression. The stock is drawn out in this step in much the same manner as the blacksmith draws out stock on the anvil or under the spring hammer. Following this step, the work is placed in the breakdown or bending impression, where it is brought more nearly to the shape and size required to fit the roughing impression. The breakdown is preferably located on the right-hand side of the die, in order to make it easy for the workman to swing the bar. In some exceptional cases, the roughing impression may be omitted and the work transferred direct to the finishing impression from the breakdown. However, the life of the die is materially reduced by the omission of the roughing impression. In the case of large forgings, the finishing impression is in a separate set of dies placed in a hammer near at hand to which the work may be readily transferred.

With the exception of work having a circular cross-section, in which case the work may be rotated in the die, a fin is produced around the contour of the piece, the die always squeezing out some of the metal on the edge of the work. Unless some provision were made in the die to receive this fin the die members would be held apart to a certain extent and forgings true to size could not be obtained. Therefore, dies are provided around the finishing impression with a groove known as the flash. This is not ordinarily required around the roughing impression, as the metal rarely fills the impression completely. On average sized dies the flash is made in the form of a flat shallow recess from 1/64 to 1/32 inch deep and from 1/2 to 5/8 inch wide. The upper die part is usually made with a back flash that is generally milled about 1/4 inch from the impression and from 3/64 to 1/16 inch deep.

Occasionally a piece may be more easily and quickly worked and finished by maintaining its connection with the original bar, and all forgings are preferably worked with a projecting part to facilitate handling. Each impression must have a gate sufficiently large to support the forging projection, the gate extending from the edge of the die-block to the impression and being enlarged at the edge of the die-block to form a sprue opening. The sprue is made large enough to admit the entire cross-section of the bar.

Most forgings require trimming, small forgings being generally trimmed cold and large ones hot. Cold-trimmed forgings are usually severed from the bar by a cut-off tool which is mounted on the forging die at any convenient place. The cut-off tool is made blunt to give it long life, and so the stock is pinched off rather than cut off. Removal of the fin is accomplished under a punch press by a punch and die that conforms to the contour of the piece. The die is



Drop-forging Dies so designed that No Side Thrusts are delivered to the Machine

usually made in two or three sections to facilitate making and to readily provide adjustments for wear. The work is forced through the die and dropped to the floor. The fin is stripped from the punch and lies on top of the die until it is brushed off by the insertion of the next forging.

Allowances Necessary

In sinking the impression in the face of a die-block, several allowances must be made. As all metals expand when heated and contract when cooled, the die recess must be made larger than the forging to be produced. The common practice regarding shrinkage allowance for wrought iron, steel, copper, or bronze for hot-trimmed forgings is 1/8 inch to the foot, and for cold-trimmed forgings 3/16 inch to the foot. Then, to facilitate the removal of the forging from the die, a draft allowance must be made which varies according to the depth and cross-section of the forging. For thin forgings 3 degrees is generally sufficient, increasing to 7 degrees for deep recesses. For a central plug in a deep recess, a draft of 10 degrees is allowed in order to avoid having the metal contract and grip the plug when cooling. No draft is allowed on curved or angular surfaces. Finally, on such parts of forgings as are to be machined, a finish allowance must be provided. This is generally about 1/32 inch, but this allowance varies according to the material of the forging and its function in the machine in which it is to be used.

Often it is desired to put letters and figures on the forging, and this causes no end of trouble in many establishments. They are preferably made in recesses provided with deep flat-faced letters and numerals that give ample body to the letters and numerals on the forgings. In the case of large letters, the practice is to first lightly stamp them into the die to locate them, and then chip or mill out the recesses, after which the letters may be stamped in the die to their full depth and finished without removing a great amount of steel. The central letter is located first, and then the other letters are added on each side. In some toolrooms the letters are purchased in the form of stamps which are set into the die recesses.

Checking the Accuracy of Dies

The dimensions of a forging that will be produced by a set of dies may be accurately checked by means of a lead model made in the impressions. The die parts are first thoroughly cleaned and the impressions chalked, after which they are clamped into position and stood on end. The molten lead is next poured slowly into the die and allowed to cool, the die parts then being separated and the lead proof removed. With the exception of forgings requiring a central plug, the dimensions of the lead proof should check up almost exactly with the steel forging, since lead has about the same shrinkage as steel. In the case of a forging having a central plug, the lead model will not shrink to the same degree that a steel forging would, due to the fact that, as the lead must cool in the die, it cannot shrink around the plug to the dimension that it should. Allowance must be made for this when checking. The lead proof also provides an accurate means of checking the weight of the metal required to make a forging.

In forming the breakdown on the die, the lead proof is further utilized by sawing it into two parts along its central axis and using one-half for laying off the contour on the die-block. It is to be understood that the breakdown is not made at the same time as the face recesses. The half of the lead proof is laid on the die parts and the outline of the forging scribed on them. The breakdown must be made smaller than the forging to insure that the forging will fit in the impression; therefore, a second outline is scribed on the die parts 1/16 inch smaller than the previous one, and this forms the working line of the breakdown. All corners of the breakdown should be well rounded, and all vertical surfaces given a draft of 7 degrees. The breakdown is provided with a gate and sprue the same as the other impressions, and it is made somewhat wider than the forging to provide ample room for working.

Heat-treating Drop-forging Dies

Drop-forging dies are often heat-treated to obviate the likelihood of their faces dishing and to reduce wear. If the material used in their construction contains less than 0.60 per cent carbon, it is first necessary to carburize the surfaces by packing them in charcoal and bone or other carburizing material and heating to about 1500 degrees F. They should be held at this temperature from six to eight hours, according to the size of the blocks, and then quenched. The temper should be drawn in oil at 450 degrees F., and all corners of recesses and the cut-off drawn by means of a blow-torch to a purple color. When cool, the recesses may be polished by using oil and emery.

The quenching vat for dies of this class should be given special attention. In many shops, a simple barrel is used to hold the quenching medium. In the case of large dies, steam pockets are likely to form in the quenching, causing soft spots on the work. This is to be carefully avoided. A tank admirably adapted for quenching this class of work is one provided with an upward discharge pipe and a couple of iron bars suspended across the top. The die-blocks should be placed on the bars face down, and the water turned on full force, projecting the water against the die faces until the top corners have been cooled sufficiently to allow water to cling to their surfaces. The die should then be placed in an oil quenching tank until cold.

Rain water should preferably be used in the quenching tank; however, other good clear water is satisfactory. The bath should not be too cold, about 70 degrees F. being most satisfactory, and on some work from 80 to 90 degrees F. A bath that is too cold may extract the heat so rapidly as to develop cracks in the die.

* * *

THE MACHINERY EXPORT FIELD

The Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C., has published Trade Information Bulletin No. 212 entitled "1924 Plans for Machinery Exports," prepared by W. H. Rastall, chief of the division. This bulletin aims to furnish the American exporter of industrial machinery with information regarding conditions in foreign countries that should prove useful in developing sales campaigns during the current year.

It will not be possible for some time yet to procure statistics showing the volume of industrial machinery exports from the United States in 1923 by countries of destination. In 1922 the value of this trade was $112,288,922, of which roughly 20 per cent went to Europe, 20 per cent to Canada, 25 per cent to Latin America, and 28 per cent to Asia. In the bulletin suggestions are made as to the best methods of promoting sales in these various markets.

The bulletin deals with the exchange situation, the source and nature of competition now encountered by American manufacturers, and the position of Great Britain as the strongest competitor. Tables are given showing the machinery exports of the United States in 1910, 1913, 1919, 1921, and 1922. The leading markets are analyzed, brief reviews being given of the markets in Canada, Japan, the United Kingdom, Mexico, China, Cuba, British India, France, Australia, Argentina, Brazil, Philippine Islands, Colombia, Spain, Peru, Chile, British South Africa, Belgium, Venezuela, New Zealand, Netherlands, Dominican Republic, Germany, and Italy. The countries mentioned are given in the order in which they rank in their importance as purchasers of American industrial machinery in 1922. It is of interest to note that Japan precedes the United Kingdom; and that Mexico, China, Cuba, and British India each were more important purchasers of industrial machinery in the American market than France or Spain, for example.

LATHE ATTACHMENT FOR ELLIPTIC TURNING

By I. F. YEOMAN

The attachment shown in Fig. 1 is employed primarily for elliptical-turning operations on the punches and dies used in making oval or elliptical frames for retaining glass windows in automobile tops. The attachment is mounted either on an ordinary engine lathe or a screw machine. Elliptical work of different sizes but having the same ratio between the length of the minor and the major axes can be turned with the attachment. By making a simple adjustment, the ratio between the lengths of the two axes of the work can also be changed to meet requirements. It will be noted that the various parts of the attachment are

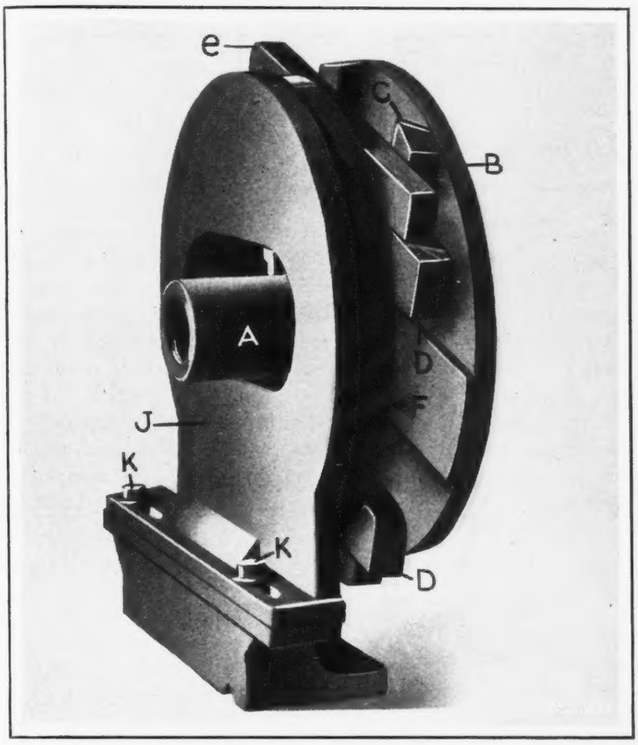


Fig. 1. Lathe Attachment for turning Elliptical-shaped Work

designated by the same reference letters in all of the illustrations.

The device is shown partly dismantled in Fig. 4. The driver *A* is a sliding member having a hub cast on one side which is threaded to fit the spindle nose of the lathe. This driver is fitted by means of a gib *C* to a dovetail groove

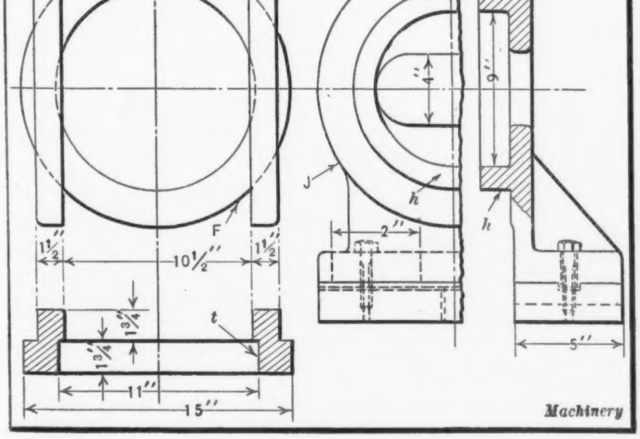


Fig. 2. Carrier-ring and Back Plate of Attachment shown in Figs. 1 and 4

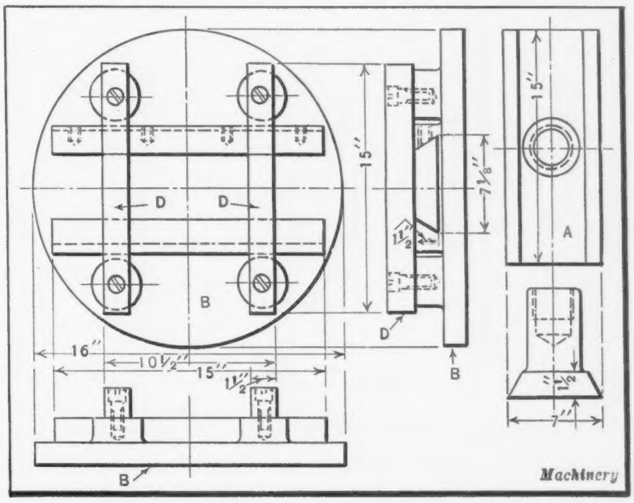


Fig. 3. Faceplate and Driver of Attachment used for turning Ellipse

in the faceplate *B*. The two bars *D* are secured to the faceplate *B* (see Fig. 3) so that they cross the top of the driver *A* at right angles. The outer edges of these two bars are parallel, and are a good sliding fit between the parallel bars *e* which are cast integral with the carrier-ring *F*. One side of the carrier-ring is bored out at *t*, Fig. 2, so that it is a running fit on the outside of the ring *h* which is turned on the back plate *J*, Figs. 2 and 4. The back plate has an oblong slot cast in the vertical member which permits it to be adjusted transversely after the driver *A* has been attached to the nose of the lathe spindle.

When the device is mounted on the lathe, it can be adjusted to machine an ellipse or oval-shaped punch or die having the desired maximum and minimum diameters. This adjustment is obtained by moving the back plate *J*

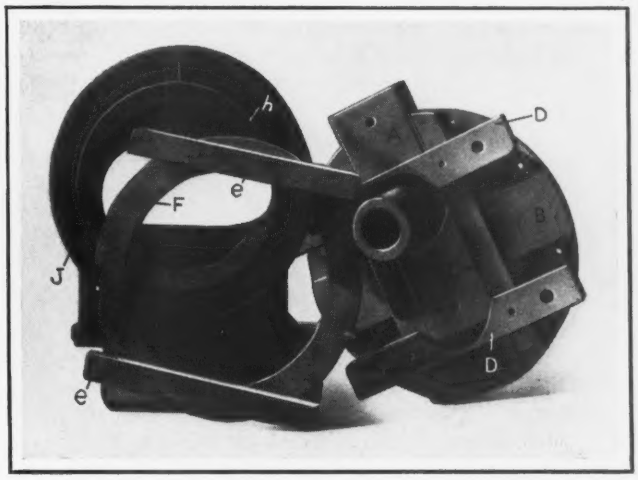


Fig. 4. Attachment shown in Fig. 1 as it appears when partly dismantled

in or out, so that its center will be located the correct distance from the center of the lathe spindle. In Fig. 5, the distance between the center of the back plate *J* and the center of the driver hub is indicated by dimension *T*. When the back plate has been correctly located, it is secured in position by means of the two bolts shown at *K*, Fig. 1. It will be noted that the faceplate *B*, Fig. 5, is supported by two sliding members which are located at right angles to each other. The driver *A*, secured to the lathe spindle, forms one sliding member, while the carrier-ring *F* forms the other. Thus the faceplate may, in one sense, be said to revolve about two different centers simultaneously.

The view at the left-hand side of Fig. 5 shows the driver *A* in a horizontal position, while in the view at the right, the driver has been rotated, in the direction indicated by arrow *L*, through an angle of 30 degrees. As the driver continues to rotate, the faceplate will be forced to slide between the parallel bars *e* on the carrier-ring *F* in the

direction indicated by arrow P. In addition to this sliding movement, the faceplate also slides in the direction indicated by arrow Q with respect to the driver A. After the driver has made one-quarter revolution, the direction of the sliding movement is reversed. Thus the combination of the two sliding movements would cause the point R on the faceplate to follow the elliptical path indicated by the heavy dot-and-dash line. It is evident, therefore, that, because of the elliptical movement of the faceplate, any piece of work attached to it will be turned to an elliptical shape.

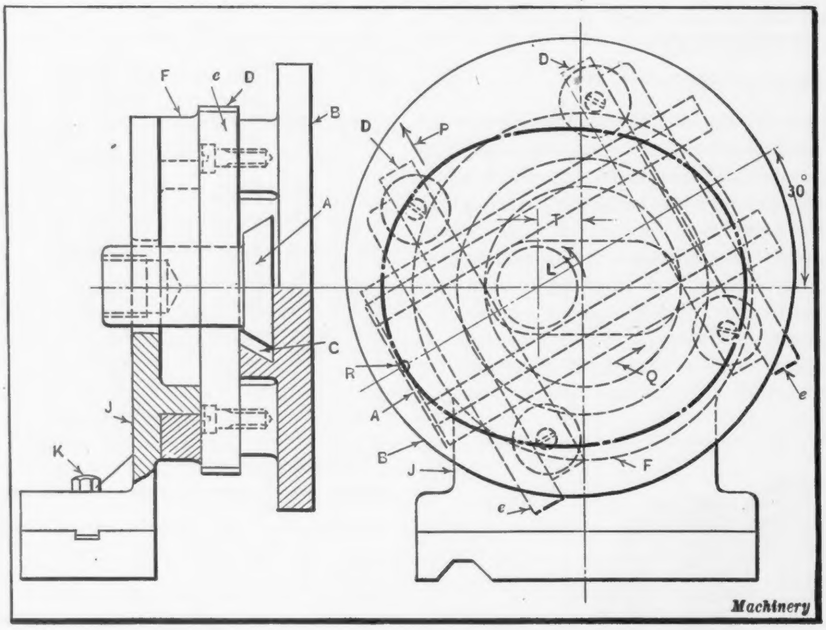


Fig. 5. Diagram used in explaining Action of Ellipse-turning Attachment

* * *

UNUSUAL POWER TRANSMISSION

By R. F. MUNDORFF

Friction power-transmitting rolls or wheels generally exert unbalanced pressures on the bearings, but in spite of this they are used extensively for high-power transmission. The pressures on the bearings may be balanced by arranging the friction wheels in planet gear formation, that is, with a central pinion, an outside race-ring, and three or more intermediate wheels. Many such arrangements embodying cylindrical or conical wheels have been proposed, but have not proved commercially successful. In most cases, although the pressures were balanced, the friction wheels were faulty in other respects so that their efficiency was much too low, seldom reaching 80 per cent.

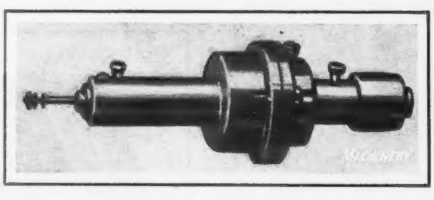


Fig. 1. Grinder Spindle with Spherical Type Friction Transmission

By using drivers of spherical shape, such as common steel balls, for transmitting small amounts of power, the efficiency of such a device may be raised to 95 or 99 per cent. A patented mechanism of this kind employed on a hole-grinding spindle is illustrated in Figs. 1 and 2. The driving shaft is shown at A, Fig. 2, and the driven spindle at B. A steel friction pinion or grooved roll C is fastened to the spindle and supported by three balls D which are about ½ inch in diameter. These balls roll on the race-ring E. Between the balls are located three rollers F mounted on journals held in the yoke G which is fastened to the driving shaft A. An emery wheel H is secured to the end of the spindle.

The friction between the emery wheel and the piece being ground will result in alternately applying a push and pull to the spindle when the apparatus is fed back and forth, so that the friction pinion C becomes pressed against the balls D. The angle at which pressure is applied to the balls is very small, so that a slight amount of pressure on the pinion in an axial direction will cause a much greater pressure in a radial direction on the balls, which is sufficient to prevent slipping when the emery wheel is smaller than the pinion.

During the operation of the apparatus, the balls will roll alternately on each side of the middle plane of the race-ring E, so that the rotation of the spindle is stopped or slowed down every time the emery wheel reaches either end of the holes and the direction of the feed changes. This prevents the ends of the hole from being ground bell-mouthed or to a larger diameter than the middle.

Spindles of this type are used for speeds up to 50,000 revolutions per minute, the efficiency at this speed being about 99 per cent. The journals of the rollers F are automatically lubricated through holes drilled obliquely in the yoke. When this type of friction drive is used for transmitting high power, the necessary axial pressure on the pinion C may be applied by a spring, a weight, or a screw, and should be adjusted so that slipping does not occur under a load three times that normally carried. Transmissions of this type may be used to advantage in combination with high-speed machinery of various kinds. An electric motor, for instance, wound for high speed and equipped with a friction speed-reducing device of this kind may be more efficient than if wound for slow speed and used without the device.

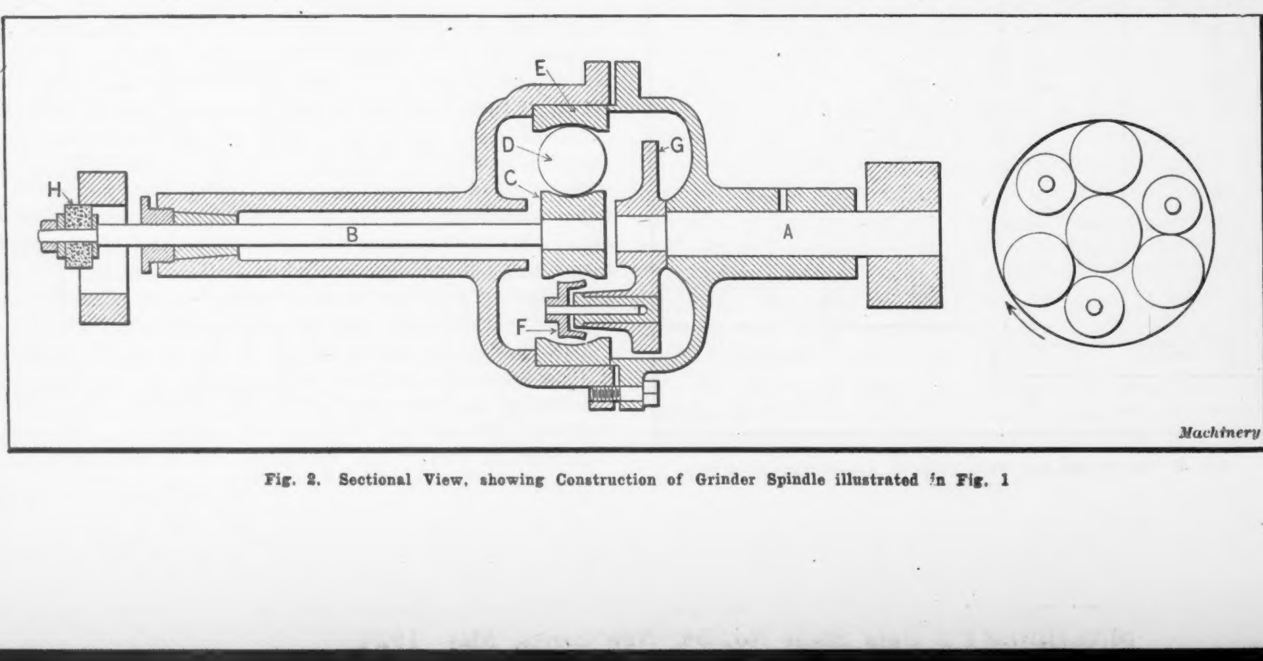


Fig. 2. Sectional View, showing Construction of Grinder Spindle illustrated in Fig. 1

CUT OUT ON THIS LINE

PUNCH PUNCH PUNCH

MACHINERY'S DATA SHEETS Nos. 33 and 34

CUT OUT ON THIS LINE

PUNCH Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH

FORMULAS FOR CIRCULAR FORMING TOOLS

To provide sufficient periphery clearance on circular forming tools, the cutting face is offset with relation to the center of the tool a distance C as shown in the illustration accompanying Data Sheet No. 34. When a circular tool has two or more diameters, therefore, the difference in the radii of the steps on the tool will not correspond exactly to the difference in the steps on the work. Assume that a circular tool is required to produce the piece A having two diameters as shown. If the difference D, between the large and small radii of the tool were made equal to dimension D required on the work, D would be a certain amount over-size, depending upon the offset C of the cutting edge. The following formulas can be used to determine the radii of circular forming tools for turning parts to different diameters:

Let R = largest radius of tool in inches;
D = difference in radii of steps on work;
C = amount cutting edge is offset from center of tool; and
r = required radius in inches.

Then:

$$r = \sqrt{(\sqrt{R^2 - C^2} - D)^2 + C^2} \qquad (1)$$

If the small radius r is given and the large radius R is required, then:

$$R = \sqrt{(\sqrt{r^2 - C^2} + D)^2 + C^2} \qquad (2)$$

To illustrate, if D is to be 1/8 inch, the large radius R is 1 1/8 inches, and C is 5/32 inch, what radius r would be required to compensate for the offset C of the cutting edge? Inserting these values in Formula (1):

$$r = \sqrt{(\sqrt{(1\ 1/8)^2 - (5/32)^2} - 1/8)^2 + (5/32)^2} = 1.0014 \text{ inches}$$

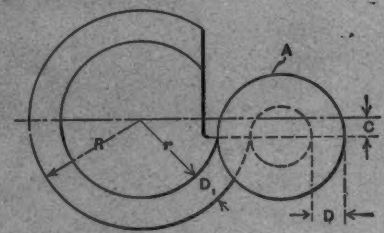
The value of r is thus found to be 1.0014 inches; hence the diameter $= 2 \times 1.0014 = 2.0028$ inches instead of 2 inches, as would have been the case if the cutting edge had been exactly on the center line. Formulas for circular tools used on different makes of screw machines can be simplified when the values R and C are constant for each size of machine. The table in Data Sheet No. 34 gives the standard values of R and C for circular tools used on different automatics. The formulas for determining the radius r, in the column at the right-hand side of the table, contain a constant that represents the value of the expression $\sqrt{R^2 - C^2}$ in Formula (1).

MACHINERY'S Data Sheet No. 33, New Series, May 1924

CUT HERE

PUNCH Punch-holes are spaced to fit standard loose-leaf ring binders for sale by stationers generally. PUNCH

FORMULAS FOR CIRCULAR FORMING TOOLS



Make of Machine	Size of Machine	Radius R, Inches	Offset C, Inches	Radius r, Inches
Brown & Sharpe	No. 00	0.875	0.125	$r = \sqrt{(0.8660 - D)^2 + 0.0156}$
	No. 0	1.125	0.15625	$r = \sqrt{(1.1141 - D)^2 + 0.0244}$
	No. 2	1.50	0.250	$r = \sqrt{(1.4790 - D)^2 + 0.0625}$
	No. 6	2.00	0.3125	$r = \sqrt{(1.975 - D)^2 + 0.0976}$
National Acme	No. 51	0.75	0.09375	$r = \sqrt{(0.7441 - D)^2 + 0.0088}$
	No. 515	0.75	0.09375	$r = \sqrt{(0.7441 - D)^2 + 0.0088}$
	No. 52	1.0	0.09375	$r = \sqrt{(0.9956 - D)^2 + 0.0088}$
	No. 53	1.1875	0.125	$r = \sqrt{(1.1809 - D)^2 + 0.0156}$
	No. 54	1.250	0.15625	$r = \sqrt{(1.2402 - D)^2 + 0.0244}$
	No. 55	1.250	0.15625	$r = \sqrt{(1.2402 - D)^2 + 0.0244}$
	No. 56	1.50	0.1875	$r = \sqrt{(1.4882 - D)^2 + 0.0352}$
Cleveland Auto-matic	1/4″	0.625	0.03125	$r = \sqrt{(0.6242 - D)^2 + 0.0010}$
	3/8″	0.84375	0.0625	$r = \sqrt{(0.8414 - D)^2 + 0.0039}$
	5/8″	1.15625	0.0625	$r = \sqrt{(1.1546 - D)^2 + 0.0039}$
	7/8″	1.1875	0.0625	$r = \sqrt{(1.1859 - D)^2 + 0.0039}$
	1 1/4″	1.375	0.0625	$r = \sqrt{(1.3736 - D)^2 + 0.0039}$
	2″	1.375	0.0625	$r = \sqrt{(1.3736 - D)^2 + 0.0039}$
	2 1/4″	1.625	0.125	$r = \sqrt{(1.6202 - D)^2 + 0.0156}$
	2 3/4″	1.875	0.15625	$r = \sqrt{(1.8685 - D)^2 + 0.0244}$
	3 1/4″	1.875	0.15625	$r = \sqrt{(1.8685 - D)^2 + 0.0244}$
	4 1/4″	2.50	0.250	$r = \sqrt{(2.4875 - D)^2 + 0.0625}$
	6″	2.625	0.250	$r = \sqrt{(2.6131 - D)^2 + 0.0625}$

MACHINERY'S Data Sheet No. 34, New Series, May 1924

CONVENTION OF NATIONAL METAL TRADES ASSOCIATION

The twenty-sixth annual convention of the National Metal Trades Association was held at the Hotel Astor, New York City, April 23 and 24. An unusually constructive program characterized the meeting. One of the important discussions related to industrial training from a practical viewpoint. Among those who spoke on this subject were John C. Spence, of the Norton Co., Worcester, Mass.; Thomas C. Shipley, of the York Mfg. Co., York, Pa., and George P. Aborn, of the Worthington Pump & Machine Co., East Cambridge, Mass. Both skilled and semi-skilled labor is becoming increasingly scarce, and the attitude of Congress toward immigration offers no encouragement for relief in the labor market. There is, therefore, only one solution to the problem, and that lies in the direction of industrial training. The National Metal Trades Association has been a pioneer in this important field, and is today recognized as one of its chief exponents.

Another subject that was dealt with in considerable detail was "The Physician in Industry." Dr. John J. Moorehead of New York City, and Dr. W. I. Clark of the Norton Co., Worcester, Mass., made addresses, and the discussion was led by Dr. O. P. Geier, of the Cincinnati Milling Machine Co., Cincinnati, O. The work of the physician in industry has a direct bearing upon such vital factors as individual production, labor turnover, labor unrest, and attendance. The subject was presented from various angles by the three physicians mentioned, who are unusually well qualified to deal with it.

Among other subjects that aroused a great deal of interest at this meeting was that treating of "Industrial Freedom." Count Ilya Tolstoy spoke on "Present Day Conditions in Russia from Within." "The New Order in England" was dealt with by S. K. Ratcliffe of London, who spoke about the present labor government from personal knowledge of the prime minister and his colleagues.

PRIZE WINNERS

Fifteen prizes were offered by MACHINERY in the February number for the best articles to be submitted on

The Most Interesting Job I have ever seen Performed on a Bench or Engine Lathe

A great many articles illustrating and describing ideas and methods of unusual interest were entered in this prize competition from every industrial section of the United States and from foreign countries. From the large number submitted, the fifteen prize-winning articles have been selected with great care, the selection being based upon such essential factors as originality, ingenuity, completeness, clarity, care, and adequacy of the illustrations.

The prize-winning articles will be published in MACHINERY beginning with the July number. Many of the other contributions are of such unusual interest that they will also be published in MACHINERY from time to time.

The prize winners and prizes are as follows:

Two Prizes Consisting of MACHINERY'S Encyclopedia:

- James W. Armour, Sanford Riley Stoker Co., Detroit, Mich.
- O. S. Marshall, 135 Wall St., Springfield, Vt.

Two Prizes Consisting of Ten Volumes Each of MACHINERY'S Mechanical Library:

- Joseph Lannen, Paige-Detroit Motor Car Co., Detroit, Mich.
- Andrew J. Weis, 31 Bruen St., Dayton, Ohio.

Four Prizes Consisting of Five Volumes Each of MACHINERY'S Mechanical Library:

- C. T. Ketz, Vlchek Tool Co., Cleveland, Ohio.
- Will C. Johnson, Elm Vocational School, Buffalo, N. Y.
- F. H. Mayoh, 7 Park View Terrace, Holyoke, Mass.
- H. C. Ten Horn, Voorstadslaan 47, Nijmegen, Holland.

Seven Prizes Consisting of Three Volumes Each of MACHINERY'S Mechanical Library:

- Francis M. Weston, Jr., U. S. Naval Air Station, Pensacola, Fla.
- A. L. Paschall, Box 71, Troy, Ohio.
- R. A. Black, 1301 Page St., San Francisco, Cal.
- Philip F. Shafran, 1878 48th St., Brooklyn, N. Y.
- Martin W. Kotawba, 1412 E. Falls St., Niagara Falls, N. Y.
- George W. Jager, 40 N. Spring St., Bloomfield, N. J.
- Henry J. Appel, 1342 Selby Ave., St. Paul, Minn.

MACHINERY appreciates the very effective co-operation of so many readers. The practical results of their efforts will be of definite value to thousands of readers everywhere, who will derive useful ideas, suggestions, and stimulus from these excellent articles.

INDUSTRIAL PREPARATION FOR WAR EMERGENCIES

The War Department, in order to be able to obtain without delay or difficulty the many different items required for putting an army in the field should this again be necessary, has prepared lists of the various articles required, the quantities needed for a given size of army, and the sources of supply. The lists prepared show that 35,000 separate finished articles are required for the complete outfitting of an army in the field, and that the number of dissimilar parts that have to be ordered on separate orders to complete these 35,000 articles are 750,000. In view of this, is it any wonder that some mistakes were made when we prepared to equip an army of 4,000,000 men within a comparatively brief period, and without any previous experience in handling a mobilization of this magnitude, or any adequate organization for doing this work? By preparing the information required, so that it is available in an emergency, the War Department, in the case of war, would be able to save a great deal of the expenditures that were unavoidable during the last war.

During the last ten months of the past war, the average cost per day of prosecuting the war was $44,000,000. Hence, purely from an economic point of view, the shortening of the war by only a few days would mean a very material saving in the cost and taxes, not to speak of the inestimable value of the thousands of lives that may be saved in that way. Adequate preparation for a possible war does not lie merely in having an army and equipment on hand to prosecute a war, but perhaps mainly in having the information on hand as to where and how the necessary equipment can be manufactured. Lack of information on the part of a hastily gotten together organization for acquiring war materials during the past war was responsible for a great deal of expense that could have been avoided if such information as is now being compiled had been available at that time.

EDITORIAL COMMENT

on Mechanical Subjects of Current Interest

EFFICIENT MILLING CUTTERS PAY

Some manufacturers who have equipped their plants with expensive high-powered milling machines are not obtaining the maximum return on their investment, because cutters of unsuitable design or inferior quality are being used. It is poor economy to spend thousands of dollars on heavy, powerful machines when they fall short of their productive capacity because tools are used that are less efficient than the machine. The difference in cost between the mediocre milling cutters and the best is not great, and to save on cutters when high-duty machines are used is foolish economy.

Great improvements have been made during recent years both in the design of milling cutters and in the materials used for them. There are now several types of milling cutters on the market that will enable the owners of heavy-duty milling machines to get the full value out of them. It is impracticable to advise specifically what types of cutters to use, because the material to be cut and the conditions under which the milling is done must influence the design of the cutter; but it will pay users of milling cutters to submit their problems to experienced cutter manufacturers and obtain tools that are most suitable for the work in hand. For some work the coarse-tooth cutter should be used; for others, finer spacing is best. The cutting angles of the teeth also vary with the conditions. In cases of doubt, the advice of manufacturers who have studied milling cutter problems should be sought.

* * *

MAKE YOUR BRAIN WORK

Two men travel over the world: One returns with his mind broadened and with lasting impressions of what he saw. He will apply those impressions intelligently to technical and business problems at home. The other, whose eyes may have beheld the same scenes and objects as the first traveller, has retained no impression of them and received no lasting benefit from his observation.

Two men are taken through a manufacturing plant: One sees the operation of principles and methods that can be applied with profit to his own work. The other comes away with no more lasting impression than he receives from an ordinary movie film.

Two men read the same article in a technical journal: One immediately sees its application to his own work and applies the information to advantage in his own shop or drafting-room. The other is unable to see any similarity between his work and that described in the article, and therefore gets no practical benefit from it.

The value of technical journals to readers depends largely on the readers themselves. A description of all the methods of manufacturing the different machines and devices produced in metal-working plants would require thousands of pages; but the principles involved in all machine shop practice are comparatively few. Most of them are covered from time to time in the technical journals and in the numerous technical books now available; but no publication can supply the ability to apply these principles to a man's work.

The writer recently visited a locomotive repair shop conducted along unusually efficient lines, where a fixture was used in machining certain links of the valve gear. The man in charge mentioned that he had obtained the idea for this fixture from MACHINERY. He was told that we had never described a fixture for machining that particular locomotive part. "No," he said, "the article from which I got this idea described the machining of automobile connecting-rods; but, you see, the work we do on these links requires exactly the same principles of machining."

* * *

STANDARDIZING STANDARDS

The Engineering Standards Committee of Great Britain has used for years a uniform method and style for publishing reports on standards adopted through cooperation with British manufacturers and users of engineering products. The American Engineering Standards Committee, engaged in a similar work, has furthered standardization in many industries, but the American reports are not uniform in character, size, or arrangement, being published by the different organizations interested and not by the American Engineering Standards Committee, its function being simply to authorize the adoption, as standards, of such reports as it passes on.

In fostering the principle of standardization, and in bringing numerous industrial bodies into cooperation with each other, the American Engineering Standards Committee has done a splendid work; but its usefulness can be further augmented if the committee itself publishes these reports, giving due credit to the society that originated them. They should conform to the requirements referred to, and should be obtainable from one source, at a moderate price, but sufficient to cover publication costs. These reports should be consecutively numbered, so that users could obtain a complete file of the accepted standards, in uniform size and style, for convenient reference.

* * *

SIMPLICITY IN TECHNICAL WRITING

The desire to appear "learned" has caused many mechanical writers almost to destroy the value of what otherwise might have been important contributions to technical knowledge. Instead of using simple phraseology that is understood by mechanical readers generally, some writers make an effort to find unusual terms and expressions which impart to their articles an atmosphere of scientific attainment.

That is one of the poorest kinds of technical writing. The best is that which deals comprehensively with the subject, but which employs only such words and terms as are generally understood by those to whom it is intended to impart information and knowledge. When it is necessary to employ unusual terms or expressions, they should be defined or explained in simple language. Many people in ordinary conversation use simple words and therefore make their meaning clear, but in writing they use long, involved sentences and uncommon words.

A political committee trying to formulate a platform found itself unable to agree upon the wording, and finally appealed to a leader noted for the use of clear expressions. He asked the chairman of the committee what he wanted to say, and was told in very simple words. He then asked each of the other committee members, "Is that what you want to say?" and they all agreed. "Well then," he replied, "say just that."

Formulate in your mind, in the same way as if you were talking, exactly what you want to say. Then say just that. Don't worry if the sentences seem brief and if they lack long and high-sounding words. If your idea has value and you have expressed it clearly, it is good technical writing.

Needed Reforms in the Patent System

By Professor THOMAS A. HILL, Member of the United States Supreme Court Bar, American Bar Association, and American Society of Mechanical Engineers

The American patent system is conceded to be one of the best in the world, but it has several serious failings which can and should be remedied, and two national legal bodies are now considering this subject. Public interest is not yet fully awakened to the harmful effects of certain existing conditions in the patent system, and if the past is any indication of the future, there will not be any effective reform until the manufacturer, the inventor, and the investor familiarize themselves with the conditions, and take an active interest in furthering such remedial legislation as is necessary.

ABOUT one hundred thousand patents are applied for annually, and practically all of the patents granted for the last seventeen years (nearly a million) are still in force. More than a thousand officials and employes of the Patent Office, several hundred federal judges, and thousands of patent attorneys are engaged in the disposition of questions arising under the patent laws. Hundreds of millions of dollars are invested every year in the solution of scientific, legal, and commercial patent problems, and a large percentage of that vast wealth and energy is wasted because of ignorance, carelessness, or fraud encouraged by our patent laws and regulations. To the end, therefore, that some of the more important shortcomings of the present system may be better understood, and that greater interest may be stimulated in a much needed reform, the following facts and suggestions are presented.

Uncertainty of Patent Rights

One failing of the present system, not generally understood, is the fact that an intending purchaser of or investor in an invention or a patent cannot make certain that the title to it is clear. While it is true that a register of patent transfers is kept at the Patent Office for recording the transfers of patents, the law does not require that licenses or shop rights be recorded, but both are good in law, even when not in writing. In fact, either licenses or shop rights may be implied, and will stand good against a subsequent purchaser of or licensee under the patent. Therefore, to minimize opportunity for often practiced fraud, all interests in a patent or a patent application should be certified to in writing, and should be promptly recorded; and an unrecorded right should have no legal force against anyone else who has in good faith secured and recorded a right under the patent or patent application.

Where a shop right has been acquired by operation of law, such as in the case of an invention made by an employe under legal obligation to an employer, if the employe refuses to certify in writing to the shop right of the employer, the latter should be entitled, upon duly prescribed legal proceedings, to an order of court to be placed upon the transfer of patents, certifying the shop right. Any outstanding license or shop right reduces the value of a patent monopoly, and a subsequent sale of or license under the patent, without notice of such prior outstanding license or shop right, is clear fraud upon the purchaser, who has remedy only against the patentee; and frequently, the latter is financially irresponsible. An assignment of even one-hundredth part of a patent is as good as 99 per cent, and such assignment may destroy the value of the monopoly. Furthermore, a patent title search should extend back as far as the lives of the transferors of the patent, any of whom may have previously become legally bound to convey all future inventions or improvements of a similar nature to some other person, firm, or corporation, and who therefore may be unable to give good and sufficient title to a prospective purchaser or licensee.

Filing of Patent Applications Should not be Kept Secret

As every patent is applied for, that fact should immediately be recorded, and the record should be made available to the public, giving the name of the applicant, title of the invention, and date of application. The filing of all applications is now kept secret, with the result that the purchaser of a license, an interest in a patent, or a patent application, sometimes later on finds that the vendor, or someone else, had another patent application pending in the Patent Office for a similar invention at the time of the sale, which pending application, if known to the purchaser at that time, would have precluded the sale.

It is not uncommon for a patent application to remain secret in the Patent Office for years, during which time others, not knowing of the application, have innocently used the invention instead of other devices equally serviceable; and the grant of the patent afterward has caused serious losses, changes in industry, and other great inconveniences and expense. In fact, this legal method of "holding up" industry at the expense of the public has become quite popular and lucrative. There seems to be no good reason why all patent applications should not be open to public inspection after they have been pending in the Patent Office for two years, so as to limit this period of public suspense and danger. Under the present method of keeping applications secret for an indefinite period, the life of a patent monopoly is unduly prolonged, and no manufacturer can tell when he is going to be "held up" for royalties, or be served with an injunction for infringement; and intending purchasers of patent interests as well as applicants for patents, are kept in needless uncertainty regarding the possible existence and effect of pending patent applications for similar inventions.

Indicating Limitations of Rights when Granting Patents

It is the usual and proper practice of the Patent Office to cite prior patents, literature, etc., against an application for a patent for an invention, where the same discloses similar ideas; but by amendment and limitation of the application, the applicant usually avoids such references; and a patent, so limited, is subsequently granted upon the amended application. A subsequent purchaser or licensee rarely understands the limitations of the patent, and even an attorney cannot properly construe it without knowledge of the state of the art or industry prior to the date of the invention of the patent; and so it becomes necessary to look up and review the prior art investigations of the Patent Office. On the other hand, if suitable short reference to the prior art were printed in the granted patent, and also in the copies of it, much of the attorney's time and of the client's expense would be saved; and uninitiated investors, who frequently do not retain patent lawyers, would be able to see at a glance that many so-called "basic" and "broad" patents are in fact very limited patents for mere shadows of invention of no real or appreciable value.

The Effect of Foreign Patent Applications

It may be that a foreigner has already filed in his own country a patent application for an invention upon which a patent application is subsequently filed in the United States by a citizen of this country. No amount of searching here would disclose that fact, and yet the foreigner can file his application for the same invention in the United States any time within a year after filing his foreign patent application, and the date of his foreign patent application is applied to his United States' patent application against the application subsequently filed here by a United States citizen. Publication of United States patent applications two years after they are filed would not help in such a situation, and for that reason, the publication of an application filed here, after a foreign application has been filed on the same invention, should be two years after the first filing of the application in any foreign country. By this method, a purchaser of or licensee under a United States' application or patent can, by suitable reservation covering a two-year period, avoid the dangerous contingency of subsequently becoming liable for infringement of a patent which was not known of here at the time of purchasing or taking license under the United States' patent application.

A patent application, in a sense, protects an invention the same as if the patent had been granted, except that no action for infringement of a patent can be instituted until the grant has been made. However, it is not wise to unduly hasten the prosecution of an application, for the reason that corrections and amendments which can be made during the prosecution of the application cannot be made after the grant of the patent, except by having the patent reissued; and that may give rise to what are termed "intervening rights," which may render the patent practically valueless.

Where a patent has been granted with needless limitations which render a competitor's product non-infringing, and a broadened reissue of the patent is thereafter obtained, the competitor cannot be held for infringement, even though the patent as reissued covers what the competitor is continuing to manufacture. The right of the competitor to produce the product intervened when the limitations of the monopoly, within which the competitor was not included, were published in the granted patent; and the subsequent repudiation of those limitations by the patentee could not disturb the right of the competitor which was acquiesced in by the publication prior to the repudiation. The competitor's continued manufacture, use, or sale of the invention thus destroys the patent monopoly, and he can legally continue to produce the infringing product as if no patent existed. This serves to emphasize the importance of great care in the original filing and prosecution of a patent application, and of not unduly hastening the grant of the patent.

Patents dominate many of the industries engaged in the manufacture of machinery of all kinds, household articles, building materials, food supplies, agricultural implements, transportation, heating, lighting, and telephone equipment, clothing, medicines, and surgical apparatus, to mention only a few of the thousands of necessities in all walks of life. In fact, there is scarcely a commodity of importance to modern civilization that is not directly or indirectly affected by one or more patents, involving the control of both manufacture and distribution, the vital importance of which can hardly be overestimated.

Renewal of Lapsed Patent Applications

In addition to reissues, there are several other forms of grant that should be better understood, and concerning which there is room for improvement. After an application has been allowed, it is sometimes permitted to lapse for one cause or another, but the law gives the applicant two years within which to renew it, and this long period is sometimes the cause of serious trouble, for the reason that the application is kept secret all the while, and a renewal of a lapsed application is often filed only as an afterthought to hold up some manufacturer who, unaware of the embryo monopoly, innocently makes use of some form of the invention. Even if the manufactured form of the invention is not covered by the lapsed application which is thereafter to be renewed, the applicant may be able to legally "amend" his renewal application and thereby bring the manufactured form of the invention within additional or amended claims of the renewal application and the patent issued, so as to establish ground for an infringement suit against the manufacturer. This is exactly what sometimes happens.

"Continuing" Patent Applications

These industrial "hold-ups" are abuses of law never contemplated by the framers of the constitution, nor were they intended by the patent statutes. Renewals should be made promptly, and further "amendment" should not be permitted. It is a loose and harmful practice, which is not destined to advance the sciences nor the useful arts. The same may be said of what is termed a "continuing" application. This is an application filed for the same invention before the abandonment of an original application, and it may be continuous in part or as a whole.

The original idea back of this practice probably was well intended, and has served many useful and legitimate purposes, but as carried out today, there is apparently no limitation as to the number of continuing applications which an applicant can file and thus indefinitely delay the issue and publication of a patent, during all of which time, as the industry develops, he is advantageously situated to claim forms and characters of invention which never occurred to him when he originally applied for the patent. The two-year period previously urged for opening applications for public inspection, if reckoned from the dates of the filing of the original applications, would automatically remedy the evil growing out of the "continuing" and "renewal" patent application practice.

Divisional Patent Applications

We now come to what are termed "divisional" patent applications. A divisional application is filed for a workable and complete part or division of the subject matter of an original application. A patent application (sometimes termed an "omnibus" application) for a machine for feeding, forming, wrapping, and delivering a product may claim the machine as a whole, or, after being filed, may be divided into four applications for the four separate sets of mechanical operations. If the machine were claimed as a whole, the omission of any one set, or the use of less than all sets of operating parts, by anyone, would avoid infringement, and so, four separate patents are, of course, proper and desirable. Divisional patent applications, like renewals, continuations, and reissues, are dated back as of the date of the original application, and for that reason, the original application should be opened to public inspection two years from the date of filing the original application.

There are also other forms of divisional patents that might be considered to advantage. A process and a product may be combined in one patent application, but there is no legal obligation for so doing. Sometimes the machine by which the process is performed is new and useful, and sometimes there is originality and merit in the design of the product. Also, there may be novelty and utility in the composition or compound of which the product is made, and so it may be desirable to take out separate patents on the process, product, composition, machine, and design. If all of these divisions are not patented, someone else may patent the unpatented division or divisions of the inven-

tion, and thereby prevent the use of the patented division or divisions by the inventor.

For instance, if you patent a product, and fail to patent the only process by which it can be made, someone else may do so, and prevent you from using your patented product. Furthermore, by taking out several patents covering the different forms of the invention, the possible invalidity of any one of them still leaves the others protected.

Interference Proceedings

Where two or more persons apply for a patent on substantially the same invention, the Patent Office declares what is known as an interference proceeding. Usually this is a long drawn-out and expensive legal contest of several years' duration, and is intended to enable rival contestants for the patent to prove by witnesses and exhibits, which of the several applicants is prior and entitled by law to the grant of the patent; because the first to file a patent application is not always entitled to the patent.

At first, a preliminary oath is filed by each applicant, setting forth facts as to the time of his creation of the invention. After that, motions and counter-motions are prepared, served, filed, and argued at the Patent Office in Washington. Then proofs are taken, by the examination of witnesses, and by exhibits, in such places as are necessary. The entire record, including exhibits, is then sworn to, printed, and filed in the Patent Office, and a final hearing subsequently takes place there. This is subject to appeal to the Board of Examiners, the Commissioner, and finally, to the Court of Appeals of the District of Columbia.

After all this is over, and the inventor has "mortgaged his soul" to pay for printing, lawyers, traveling, official fees, etc., (assuming that he has defeated his opponents) and has been adjudicated by the court of last resort to be entitled to his patent, his defeated opponent, or any one of several of them, can then file a bill in equity (Sec. 4915 R.S.), in an inferior court (U. S. District Court), to compel the grant of his defeated patent application, and can then introduce "new evidence" to prove that he was the prior inventor, so as to overcome the decision of the superior court previously rendered. Even after that, further appeal may be made to a Circuit Court of Appeals of the United States, where the invention may, after years of ruinous and nerve-straining litigation, be declared inoperative, or unpatentable for some other reason. If the inventor can then show that the last court was wrong, he can start further litigation and expense, provided he lives long enough and can get money enough to pay the lawyers.

This illustrates what Congress and some members of the legal profession consider advancing the arts and sciences of the nation, by offering patents as incentives for the development of inventive genius. A law that thus unduly prolongs legal contests between rival inventors serves no legitimate purpose, and is a temptation for fraudulent and oppressive litigation, for which reason Section 4915 of the United States Revised Statutes should be repealed.

One failing of the present patent system that is not generally understood is the fact that an intending purchaser of, or an investor in, an invention or a patent cannot make certain that the title to it is clear. While it is true that a register of patent transfers is kept at the Patent Office for recording the transfer of patents, the law does not require that licenses or shop rights be recorded, but both are good in law, even when not in writing. Therefore, to minimize the opportunity for possible fraud, all interests in a patent and in a patent application should be certified to in writing, and should be promptly recorded.

Avoiding Infringement Suits by Filing Patent Applications

While on the subject of patent interferences, it is well to note that the value of filing a patent application is not limited to its direct protection of an invention. An application prevents the grant of a patent to another for the same invention until after an interference contest between two or more pending similar applications has been disposed of. For that reason, before commercially introducing a new invention, it is advisable to file a patent application therefor, to make certain that no patent will be issued on some other application simultaneously pending for the same invention.

While it is true that patent litigation may develop whether this precaution is taken or not, nevertheless an interference proceeding is preferable to an infringement suit, for the reason that the former may result in patent protection, whereas the latter may result in an injunction and damages or loss of profits because of infringement. The publication of the titles, dates, and names of applicants of original patent applications as they are filed, and the opening of applications for public inspection two years after, will undoubtedly reduce the number of interference proceedings and the attendant waste of time and expense.

Delays in Issuing of Patents

The long delay in the issuance of patents is not always the fault of the Patent Office examiners, as some seem to think. More often, and in fact generally, it is the fault of applicants or attorneys who take the entire year allowed by law for answering each Patent Office action in their cases. In this way, by continuing, divisional, and renewal applications, cases are sometimes maintained in the secret archives of the Patent Office for a dozen or more years.

There seems to be no need of allowing a year for making an amendment to an application, which ordinarily should not require more than an hour or two, and the time might well be cut to six months. A patent pending twelve years and then granted for seventeen years, is actually a monopoly for twenty-nine years, and that is hardly fair to the public. The public disclosure of inventions after they have been pending in the Patent Office for two years will render the habit of delaying the issue of patents less desirable to those who pursue that practice.

Reverting again to the subject of Patent Office interference, it is urged that time and expense would be saved, and the interests of justice advanced, by open trials of the issues. In other words, instead of in each case holding numerous hearings before notaries in various parts of the country over needlessly extended periods of time, and loading the typewritten record with many pages of irrelevant matter and mere argument of counsel, the hearing should be held in the Patent Office, the same as any other trial held in open court. It is safe to say that the records and expense in most cases would thus be reduced one-half, and that Patent Office officials would be relieved of considerable needless review of records, exhibits, and motions. By preventing, in this manner, prolific and costly displays of legal "talent," clients would save fees, anxiety would be shortened, business less interfered with, and entire industries would often be relieved of expensive delays and intimidation.

In a recent preliminary report of the committee on Patent Law revision of the American Bar Association, the following (referring to patent interferences) appears:

"We know of no other proceeding known to the law in which litigants are entitled as a matter of right to at least two appeals on interlocutory proceedings, and in addition four appeals and two original proceedings, as to the same contested state of facts, making a total of four appeals on the merits."

The report then continues with the suggestion that there be no direct appeal from interlocutory orders, and that all

appeals to the Commissioner of Patents be abolished. One member of the committee objected to the latter suggestion on the ground that (referring to the office of the Commissioner of Patents) this would impair the dignity of the office, and the respect of the public for the patent system would suffer in proportion.

While it is fully appreciated that an opinion from a recognized specialist, such as a Commissioner of Patents, is of great value on any Patent Office question, the joint opinion of the three experts constituting the Board of Examiners-in-Chief of the Patent Office is probably entitled to as much weight, and the large volume of other Patent Office business included in the official responsibilities of the Commissioner and his assistants, would seem to leave those already overworked officials little time to spare for the proper consideration of many intricate questions involved in the numerous Patent Office appeals. Matters of alleged impaired dignity of office, or supposed lack of respect for the patent system seem to be more imaginary than real, especially as final appeal could still be made to a Federal Court of Appeals.

Supporting Claims for Inventions

In the same report there is another suggestion to the effect that—"any oath of inventorship shall be sufficient to support all claims of a patent for any invention coming within the scope of any claim supported by such oath." It must be presumed that "any" oath means one in accordance with statutory requirements. The point here may be that an application may fully disclose a valuable invention, but only partly claim it. Under the present state of the law, claims thereafter added to include the matter originally disclosed but not claimed are invalid unless sworn to in a separate and additional oath. This seems to be an application of legal technicalities, and such ground for invalidating an otherwise valuable patent should be removed, and the original oath which has been filed in an application fully disclosing an invention, if in conformity with statute, should be sufficient for all purposes of law.

Under the law, when infringement is found against a defendant, and the defendant tries to modify or change the infringing structure so as to avoid contempt of court by further infringement, there are no prescribed and satisfactory means for ascertaining the attitude of the court regarding the modified or changed structure, and the defendant may therefore be obliged to proceed with the changed or modified structure at his own risk. For this reason, special provision should be made for further and subsequent adjudication exclusively upon that question, at the expense of the defendant. This would lessen unpleasant, time-consuming, and expensive contempt prosecutions which clog court calendars, embitter litigants, and disgust the industry.

A Court of Patent Appeals is Needed

The decision of a Federal Circuit Court of Appeals of one jurisdiction is not always followed by a Federal Court in another circuit, with the result that what infringes in one state can sometimes legally be produced and sold in another state. This situation inspires neither confidence in, nor respect for, the judges, and adds to the uncertainties of the patent system. The Supreme Court of the United States may relieve such a situation after delays, but a Court of Patent Appeals, having jurisdiction throughout the United States, is the logical solution, for the obvious reason that nine different Circuit Courts of Appeal, some of the judges of which are not the most expert in patent law, and many of whom are overworked, cannot always be expected to be in agreement on all points involved in patent jurisprudence.

Marking of Patented Articles

The law now requires a patentee or licensee to mark his patented articles with the date of the patent in order to notify others not to reproduce it; otherwise the right to recover damages or lost profits for infringement may not be available. This is an antiquated and impractical method of giving notice of patent, as about a thousand other patents are granted on the same day, and it causes unnecessary difficulty in looking up the patent to learn of its legal significance and limitations. The law should be changed so as to require that the word "Patented" be used with the patent number after it.

Industrial Patent Arbitration Boards

As a means of simplifying, expediting, and lessening the expense of contested patent disputes, it is suggested that each of the industries might find it of mutual benefit to have a patent arbitration board or committee, and by agreeing to submit all patent disputes to it, might, to some extent, have, in effect, the benefit of what has long been denied them—a patent court of appeals. The alert executive should need no further argument to make him appreciate the beneficial possibilities of such a method of expeditiously disposing of these perplexing issues of the trade.

Patent Insurance

As an alternative suggestion, consider the establishment of a patent underwriting system—a kind of insurance against damage from infringement arising from the manufacture, use, or sale of an approved commodity, and as a guarantee for the legal preservation and enforcement of approved patent rights.

At present, in New York City, it takes more than a year to reach trial in a patent infringement suit, and for that reason it is impossible for manufacturers entangled in patent litigation to know what to expect or how to calculate the future. Many of the larger corporations are obliged to maintain expensive patent departments, and many of the smaller ones are hampered by injunctions. Added to these is the legitimate inventor, who is unable to interest capital because of diminished public confidence in patent investments, resulting largely from the fraudulent exploitations of his less legitimate brother.

If thoroughly sound patent insurance were available, the payment of an annual premium would eliminate all questions of loss, and the cost would be insignificant in comparison. The patent or commodity that was refused patent insurance would be wisely and universally avoided, and those that were accepted, could be exploited without fear of loss and with as much confidence as now applies to fire insurance. Such a business would be legitimate.

Some lawyers object to this plan on the ground that it would interfere with their professional business. Without commenting on the virtue of that objection, it is confidently asserted that patent insurance would, on the contrary, increase the professional business of good patent lawyers, as it would increase patent investments. The merit of the proposal is that all parties, directly or indirectly connected with such matters, would be benefited, and above all, there would be greater stimulus for legitimate invention, with less opportunity for frauds perpetrated under the guise of safe and promising patent promotions.

Concluding Remarks

An open conference has recently been held between the Patent Section of the American Bar Association and members of the American Patent Law Association, but the only report presented by the committee charged with the duty of preparing suggestions and recommendations for improving the patent system comprised a brief tentative recommendation for eliminating a few appeals in Patent Office cases. This was referred back to the committee for a fuller report at the next meeting, which takes place in July. In the meantime, it is for chambers of commerce, manufacturers' associations, engineering societies, and other civic and technical organizations, to appoint committees to investigate and report upon the conditions set forth, so that concerted action can be taken for the benefit of all.

American Gear Manufacturers' Convention

THE eighth annual meeting of the American Gear Manufacturers' Association was held at the Hotel Lafayette, Buffalo, N. Y., April 28, 29, and 30. As usual, one of the outstanding features of the convention was the great number of reports presented by the society's standardization committee. As has been frequently pointed out in the past, no association in the industrial machinery field, apart from the Society of Automotive Engineers, has given so much attention to standardization activities as the gear manufacturers. At every session during the meeting one or more of the reports of the standardization committees were presented, and further work along standardization lines was outlined.

George L. Markland, Jr., of the Philadelphia Gear Works, president of the association, opened the first general session with a brief address on "The Year in Prospect," pertaining to the special interests of the gear manufacturing industry.

Standardization Reports

B. F. Waterman, of the Brown & Sharpe Mfg. Co., Providence, R. I., chairman of the General Standardization Committee and vice-president of the association, presented two reports, one relating to the general standardization work within the association, and the other covering the work carried on by the association in cooperation with the American Engineering Standards Committee.

E. W. Miller, of the Fellows Gear Shaper Co., Springfield, Vt., presented a report relating to the cooperation of the American Gear Manufacturers' Association with the American Society of Mechanical Engineers, covering the work of the Gear Research Committee. The Massachusetts Institute of Technology has acceeded to the request of this committee to conduct important tests, the purpose of which will be the determination of the effect of varying degrees of tooth accuracy and varying velocities upon the strength of gear teeth. The information gained by this research will be essential to the solution of wear and noise problems. It was agreed that the Gear Research Committee shall provide the testing machine and test samples without expense to the institute. The institute will provide space and power for the machine and observers for carefully recording the tests, without charge.

The relation of the proposed research to the photo-elastic method, which is also being worked out at the institute, has been considered. The Gear Research Committee concedes the great value of the photo-elastic method, but believes that the machine and plan worked out by Mr. Lewis has great possibilities. The records obtained by the photo-elastic process exist in celluloid and necessitate computation to determine results in steel. In employing the Lewis machine and plan, results will be obtained directly, and there will be no question of comparison between celluloid and steel or any other material of which the gear may be made. The committee has arranged with Hugo Bilgram, of Philadelphia, to proceed at once in the making of the necessary patterns for the machine, there being sufficient funds to warrant this proceeding.

Separate reports were also presented by the standardization committees on spur gears; bevel and spiral bevel gears; herringbone gears; nomenclature; worm-gears; sprockets; electric railway, mill, and mine gears and pinions; non-metallic gearing; differential gearing; transmissions; metallurgical standardization; tooth forms; inspection; commercial standardization; and uniform cost accounting. In addition, the Industrial Relations Committee and the Metric Committee also presented reports.

Papers Read Before the Convention

As usual, the convention was characterized by the reading of several papers containing definite information on subjects of direct interest to gear manufacturers, as well as to industry in general. The papers presented were as follows: "Gear Practice in England," by W. E. Sykes, of the Farrel Foundry & Machine Co., Buffalo, N. Y.; "The Value of Cost Accounting to an Executive," by Russell C. Ball, of the Philadelphia Gear Works, Philadelphia, Pa.; "The Gear Manufacturer Needed," by L. G. Hewins, of the Van Dorn & Dutton Co., Cleveland, Ohio; "The Application of Spiral Bevel Gears," by F. E. McMullen, of the Gleason Works, Rochester, N. Y.; "Advertising as an Investment for the Gear Manufacturer," by J. C. McQuiston, of the Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; "Practical Metallography," by Stanley P. Rockwell, Hartford, Conn.; "The Management's Responsibility in Industrial Relationship," by E. S. Sawtelle, of the Tool Steel Gear and Pinion Co., Cincinnati, Ohio; "Buying Habits of Industry," by Mason Britton, vice-president McGraw-Hill Co., Inc., New York City; and "Gears and Pinions of Equal Strength," by Professor M. A. Durland, of the Kansas State Agricultural College. At the dinner held in connection with the convention, S. F. Fannon of the Sherwin Service, Inc., spoke on "The Seventy-five Cent Dollar in Business," and James B. Horn delivered an address on the world situation and its relation to business.

The Application of Spiral Bevel Gears

In his address on the application of spiral bevel gears, F. E. McMullen pointed out that curved tooth gears, both spur and bevel, are being applied to a greater extent as their qualities of operation become more familiar. Spiral bevel gears, which bear the same relation to bevel gearing that helical gears do to spur gearing, have been commercially available for the last ten years, a time sufficient to provide information from which practical conclusions can be drawn regarding their application.

There is naturally a great similarity between helical spur gears and spiral bevels in that there is the same continuity of pitch line contact, axial thrust, and proportionately greater strength, all of which insure quiet and durable operation when properly designed, made, and mounted. The axial thrust produced by the operation of spiral bevels must be fully taken care of when mounting the gears, and failure to do so can only result in poor performance or short life of the gear. The importance of this point cannot be overstressed, for a strong, inflexible mounting insures almost unlimited life to a well-designed set of casehardened gears. A point to consider in bevel gears is that it is seldom possible to mount both members of a pair *between* supporting bearings—one member, or perhaps both, overhangs its supporting bearing.

The effect of displacement of gears in the mounting when working under load can be readily observed on the tooth contact. When a set of bevel gears is displaced from the proper running position, the tooth contact is shortened lengthwise and is located near the top of the tooth. In bad cases, the load becomes concentrated on the top corner of the tooth at the large end. There can be little question why spiral bevel gears operating in such abnormal fashion are noisy and break, for the continuity of pitch line contact—the main virtue which induces quiet operation—is lost, and the operating load is concentrated on a small area rather than distributed across the tooth as it should be. In spite of the lack of proper mounting in many cases,

spiral bevels have given good service due to their inherent characteristic of being able to stand a greater displacement than straight bevels before unsatisfactory results are in evidence.

There are four distinct qualities that differentiate spiral bevels from straight bevels: (1) Quiet operation at high speeds; (2) smoother action at low speeds; (3) greater proportional strength; and (4) cheaper quantity production. The adoption of a spiral bevel gear drive is often decided upon by one or more of these qualities.

The first general adoption has been in the automotive field, where the development has demanded silent transmissions and rear axles. Strength has also been a large factor, for the conservative estimate of 30 per cent greater proportional strength has removed the source of trouble caused by breakage in many cases, or permitted a reduction in size, with consequent lessening of the upsprung weight. The costs have been lowered from a strictly gear production standpoint, as well as the intangible costs of assembly induced by less tear-downs and readjustments.

There are many other uses—forty-seven distinct applications in all—among them, the sewing machine, where their silent operation at high rotative speeds has recommended spiral bevel gears for household use. In a stocking knitting machine, where the needles had to be swung out of the way to load the machine, 600 needles was formerly the maximum that could be used, since the gear swung out of mesh from its driving mate, and in executing this movement there was a slight rotation which, if carried too far, would shear off the thread. A design of gear was evolved in which the tooth had a radius struck from the center of oscillation of the needle head and this caused so little disturbance in the machine setting that the number of needles was increased to 900.

Another interesting use is in the co-planar microscope, where two refracting lenses must be perfectly synchronized at all times and be capable of smooth adjustment. These gears, made of German silver, are quite small (48 pitch), and their extreme tolerance of run-out is 0.0002 inch with no backlash permitted. Common uses include phonographs, ice-cutting machinery, centrifugal dryers, vacuum cleaners, overhead camshaft drives, both on automobiles and Diesel engines, washing machines, grinders, motor reduction sets, and machine tools. From the number of experimental installations now under way, it appears that the use of straight-tooth bevel gears will be limited to slow-moving drives where smoothness is not essential.

Advertising as an Investment for the Gear Manufacturer

In the paper on advertising by J. C. McQuiston, manager of the department of publicity, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., the author pointed out that if advertising investments are wisely made, they will bring returns both in the form of good will and in additional sales. He stressed the need for a close study of business conditions, markets, and advertising mediums, before a plan for advertising is formulated, and especially emphasized the need of a definite plan, if satisfactory results are to be expected. "Make your plans at least one year in advance," he said. "One year is not too long for this purpose. It is hardly worth while to plan for a shorter period. Your total investment may look big, and in the beginning your plan may seem somewhat involved. It is important, however, that a complete picture of the advertising possibility for a whole year be visualized in some form. Only this procedure will make it possible to coordinate the various kinds of advertising with the sales efforts of the company, so as to bring about maximum efficiency."

The need for a budget was also pointed out. This budget may be based upon a certain percentage of the sales during the past year, or it may be a given percentage of the sales expected during the current year. It may also be a flat sum appropriated for advertising purposes. However determined, the appropriation should be known at the beginning of the year, so that it may form a basis for formulating advertising plans.

The method of determining upon the advertising medium to use was next referred to. Each periodical should be analyzed with care. Some of the things to be considered are circulation, class of readers, relation of advertising to reading matter, and whether the publication is a member of the Audit Bureau of Circulations, an organization which audits the circulation of any publication and issues an independent statement of the standing of the publication with respect to circulation. Style and make-up of the publication were also emphasized, as well as the importance of the editorial policy. Details of the system used in planning advertising were also referred to.

In closing, the author pointed out that while some of the gear manufacturers have done considerable advertising in the past, they have not done sufficient in proportion to the "dynamic force there is in advertising to build up new business." "I would say in general," said Mr. McQuiston, "that our gear manufacturers as a whole could safely experiment by doubling the expenditure for advertising and by careful analysis of conditions, invest it very profitably."

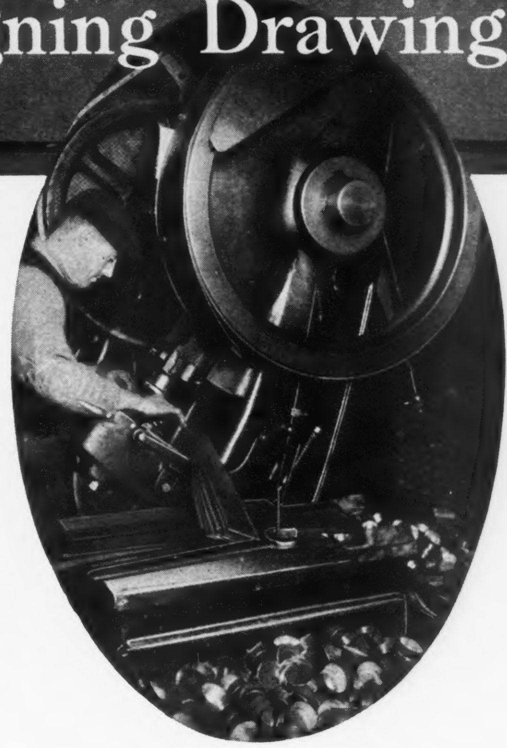
British Gear Practice

In his paper on British gear practice, W. E. Sykes reviewed the development of the gear-cutting industry in Great Britain, which has parallelled in many ways the development of this industry here. Today there are in both countries gear specialists who take full responsibility for the design, materials, and workmanship of gears produced by them, in addition to firms who merely cut gears to specifications. As an example of the developments in British gear practice, the author mentioned that he saw a pair of gears in service a few months ago that were running at a peripheral speed of 12,000 feet per minute, and transmitted 1340 horsepower. These gears were running so silently that they could not be heard because they made less noise than the generator and turbine with which they were connected.

The author reviewed briefly the subjects that at the present time are taking the attention of British gearing experts. Tooth shapes have been carefully investigated, and it is generally considered that the involute system is the best. Other systems, however, have not been neglected, and some investigators believe that better tooth shapes can be had, provided more exact workmanship can be assured. The main advantage of the involute contour is that it permits of varying the center distances. On the question of tooth height, the general opinion is in favor of comparatively long teeth, and long and short addenda appear to be favored. Smooth finish is generally required, especially in worm-gears. Accuracy in the dividing mechanisms of gear-cutting machines is recognized as of great importance, and much progress has been made in this direction. The true alignment of the teeth relative to the axis of the gear is now considered sufficiently important to receive attention. Tooth grinding of automobile gears is extensively practiced, with successful results, due to improved methods of inspection, as well as to the grinding process itself.

Standardization has made comparatively little progress in the gearing field, it being generally believed that the development work at the present time is so extensive that standardization would be inadvisable. The work of the American Gear Manufacturers' Association, however, is closely watched. Research work, to determine the mechanical efficiency of worm-gears, has been carried on for about ten years by the National Physical Laboratory, and for the last three years the same institution has conducted experiments with spur gears, with the object of obtaining information on the mechanical efficiency, load-carrying capacity, and effects of various lubricants, and various tooth shapes and tooth proportions. An ingenious machine has been developed for making sufficiently precise measurements of gear inaccuracies to enable some of these experiments to be carried on with a view to bringing out real results.

Designing Drawing Dies



By EDWARD HELLER

THE preceding article on this subject, which appeared on page 579 of April MACHINERY, dealt primarily with the general design of drawing punches, dies, blank-holders, and strippers for light-gage metal. The present article deals more particularly with the problems encountered in determining the size of the blank necessary to produce a shell of given dimensions and the number of drawing operations required to complete the work.

There are three distinct methods in general use for determining the size of a blank, namely by weight, by trial, and by computation. The first method can be used only when there is a sample to start with. In this case the sample is first weighed, after which the surface area of a piece of sheet metal of the required thickness and of the same weight as the sample is found by reference to a table giving the weights per square inch for sheet metal of various thicknesses. For instance, let it be assumed that the sample shell weighs 1/2 pound and is produced from 20-gage steel. As 20-gage steel weighs 1.25 pounds per square foot, the area of the required shell is evidently equal to (144 × 0.5) ÷ 1.25 = 57.6 square inches. Reference to tables such as given on page 48 of MACHINERY'S HANDBOOK shows that the area of a circle 8 5/8 inches in diameter is 58.4 square inches and we will therefore assume that a blank 8 5/8 inches in diameter will be about the right size.

The second method of determining the blank diameter can be used on round work only. In this case a wooden form or chuck of the required shape is turned up in the lathe, and blanks of different sizes are spun over this form by hand. A skilled metal spinner will usually be able to determine the correct blank diameter after two or three trials.

The third method—by computation—is usually the cheapest and quickest. The blank diameters for shells of the shapes shown in Fig. 1 can easily be calculated. The shell shown in the upper left-hand corner of this illustration is cylindrical in shape and has square corners or corners that are rounded to a negligible radius at the bottom. The area of the bottom can be found by reference to tables such as mentioned in the preceding paragraph. The area of the cylindrical section is equal to the height H multiplied by the circumference of a circle having a diameter D. The combined area of the bottom and the cylindrical part of the shell is equal to the area of the blank. The complete formula for the area of the blank is:

$$\pi D\left(\frac{D}{4} + H\right)$$

and the formula for the blank diameter is:

$$2\sqrt{D\left(\frac{D}{4} + H\right)}$$

Computing the Blank Diameter of Shells of Unusual Shapes

In the case of the shell shown in the view in the lower left-hand corner of Fig. 1, the computation of the blank diameter would be slightly more complicated. Here the area of the different sections of the shell are found by the formulas given in the following:

$$\text{Area of flange} = \frac{\pi}{4}(F^2 - D^2)$$

$$\text{Area of cylindrical section} = \pi DH$$

$$\text{Area of bottom} = \frac{\pi B^2}{4}$$

$$\text{Area of conical section} = \frac{D + B}{2} \times \pi C$$

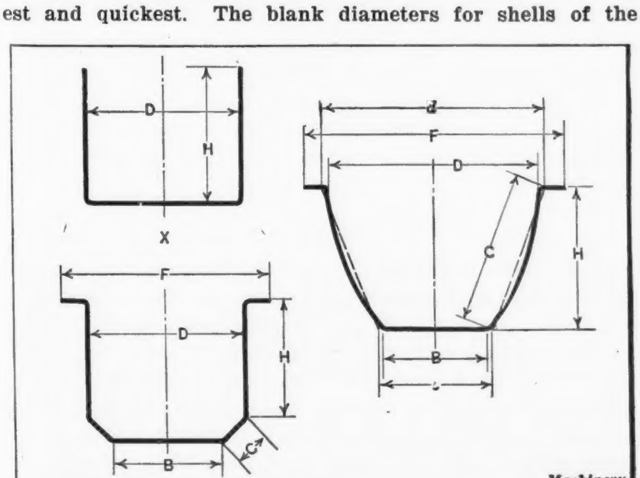


Fig. 1. Diagrams used in determining Surface Areas of Drawn Shells

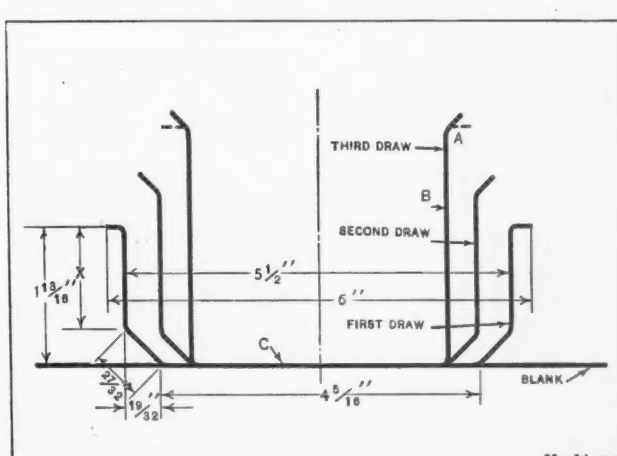


Fig. 2. Diagram used in determining Number of Operations required

Combining these formulas, we have a total area equal to

$$\pi\left[\frac{F^2-D^2}{4}+DH+\frac{B^2}{4}+\left(\frac{D+B}{2}\times C\right)\right]$$

Therefore the blank diameter would equal

$$2\sqrt{\frac{F^2-D^2+B^2}{4}+DH+\left(\frac{B+D}{2}\times C\right)}$$

The shell shown at the right-hand side of Fig. 1 is of the preserving kettle shape. For determining the blank size for work of this kind, side C can be considered as a straight line and the calculations carried out in much the same manner as outlined in the preceding example. In the present case we have the formulas for the areas of the various sections as follows:

$$\text{Area of flange} = \frac{\pi}{4}(F^2-D^2)$$

$$\text{Area of body section} = \frac{d+b}{2}\times \pi C$$

$$\text{Area of bottom} = \frac{\pi B^2}{4}$$

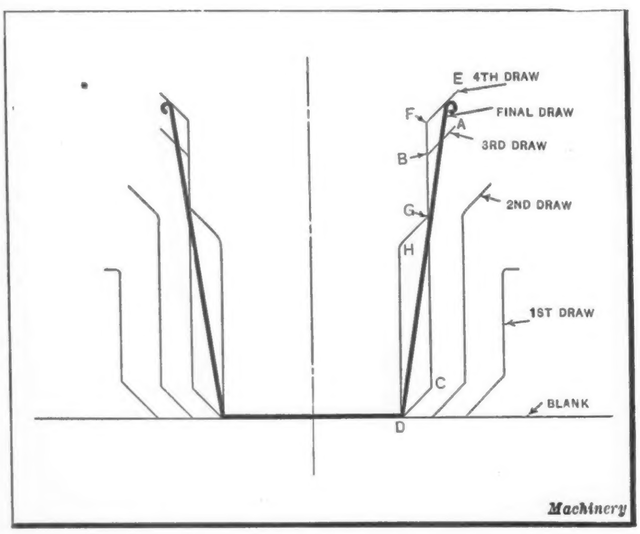


Fig. 3. Evolution of Tapered Shell such as used for Water Pails

From the foregoing formulas it will be evident that the total area of the blank equals

$$\frac{\pi}{2}\left[\frac{F^2-D^2}{2}+C\,(d+b)+\frac{B^2}{2}\right]$$

and the blank diameter is therefore equal to

$$1.413\sqrt{\frac{F^2-D^2}{2}+C\left(d-b+\frac{B^2}{2}\right)}$$

For thin-gage metal such as considered in this article, no allowance is made for the thickness of the stock in determining the blank diameter, as it would not affect the calculations an appreciable amount, especially if the inside diameters are used in making the calculations and no deductions are made for the radii at the various corners. The results obtained in this manner will be satisfactory for all practical purposes, since an allowance must always be made for trimming. In all cases the blank must be cut a little larger than the calculated size owing to the fact that slight variations in the thickness or hardness of the material will result in variations in the length of the shells produced.

Determining Number of Operations Required

After the blank size has been determined, the next problem is to find the number of drawing operations required. Let it be assumed that the diameter after each drawing operation is 66 per cent that of the shell produced in the preceding drawing operation, or in the case of a first draw, 66 per cent that of the blank diameter. In order to find the number of drawing operations required to complete the work, it is necessary to find what per cent the diameter of the finished shell is of the blank diameter and then find how many times 0.66 must be multiplied by itself to give the final percentage of the reduction in size. This can probably be best illustrated by a concrete example. Let it be assumed that a cup is to be made 3 1/4 inches in diameter by 4 inches high with a 1/8-inch bead. Also let it be assumed that it will require about a 1/4-inch flange to make the bead. Referring to Fig. 2, we have the following formulas for the areas of the various sections:

Area of flange A = 11.045 — 8.2958 = 2.749 square inches
Area of cylindrical section B =
10.2104 × 4 = 40.840 square inches
Area of bottom C................ = 8.296 square inches

Total area of blank.............. = 51.885 square inches

The nearest nominal diameter of a blank of this area is 8 1/4 inches. Now 3 1/4 is 39 per cent of 8 1/4. Therefore $0.66^x = 0.39$. Now solving for exponent x we have

$$x \log 0.66 = \log 0.39 \text{ or } x = \log 0.39 \div \log 0.66$$
$$x = 2.266$$

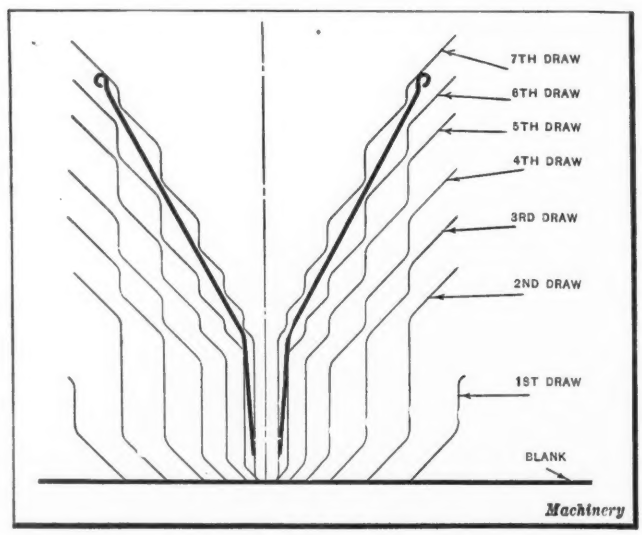


Fig. 4. Diagram illustrating Method of drawing a Seamless Funnel

Now since exponent x is found to be greater than 2, it is evident that three drawing operations will be required to complete the work. It is now a good plan to arrange the data obtained in tabular form as follows:

Operation	Amount of Reduction	Diameter
Blank		8 1/4 inches
First draw	66 per cent	5 1/2 inches
Second draw	78 per cent	4 5/16 inches
Third draw	75.6 per cent	3 1/4 inches

It will be noted that the greatest reduction in diameter is in the first drawing operation in which the blank is drawn into a shell the diameter of which is 2 3/4 inches less than the blank diameter. In the second operation the diameter of the shell is reduced 1 3/16 inches and in the third operation 1 1/16 inches.

Amount of Reduction Permissible

It is best to make the amount of reduction in the second drawing operation proportionately small. The reduction in the diameter of the work can be increased somewhat in the third operation, and generally can be increased thereafter until the final draw. As the shell becomes comparatively small, the reductions must be made proportionately larger in order to provide a sufficient amount of metal in the blank-holder wall. For this reason it is often necessary to make a 50 per cent reduction in the diameter of the work at one draw. In such cases annealing at every second or

third operation is necessary. It is well to make the steps or amounts of reduction in even figures whenever possible, as work dimensioned in sixty-fourths or even thirty-seconds of an inch only serves to complicate the diemaker's work.

For work that requires a large number of drawing operations, the amount of reduction at each successive step should be about as follows: For the first draw in which the blank is formed into a shell, the amount of reduction in the diameter may be 66 per cent; for the second operation, 78 per cent; for the third, 76 per cent; fourth, 74 per cent; fifth, 65 per cent; sixth, 60 per cent; seventh, 59 per cent; eighth, 54 per cent; etc. According to these figures, a blank 30 inches in diameter can be drawn into a shell slightly more than 1 inch in diameter in eight operations. In this case, the final diameter of the shell will be about 3 per cent that of the original blank diameter. The percentages of reduction here given need not, of course, be followed exactly, but may be varied somewhat to meet special conditions.

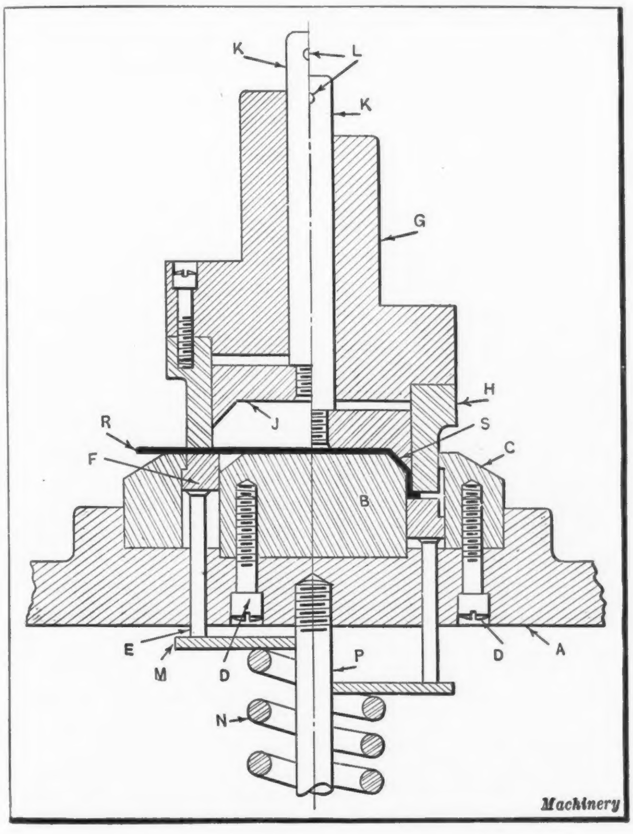


Fig. 5. Combination Blanking and Drawing Die used in the Production of Kitchen Utensils

However, the values given in the foregoing list will serve as a reliable guide in drawing the class of work usually handled.

Determining Height of Draw

When the diameters to which the shell is to be drawn in the various operations have been determined upon, the next problem is to calculate the height of the shell produced in each operation. Calculating the height of a shell is, in a way, the reverse of figuring out the blank diameter, as expressed in connection with the shells shown in Fig. 1. In the present case all values are known except the one required. For example, let us take the first drawing operation in the case illustrated in Fig. 2.

Using the dimensions given in the illustration for computing the areas of the various sections, we obtain the following figures:

Area of flange =	4.516 square inches
Area of bottom =	14.607 square inches
Area of beveled section =	13.010 square inches
Total area =	32.133 square inches

Now as the area of the blank is equal to 53.456 square inches, the area of the cylindrical part will equal 53.456 — 32.133 or 21.323 square inches. And since the area of a cylinder equals the circumference times the height or $A = C \times X$, where A = area of cylinder, C = circumference, and X = height, we have $X = A \div C$. In this case C = 17.279 and $X = 21.323 \div 17.279 = 1.234$ inches or about 1 15/64 inches. The height of the shell produced in the second or any other succeeding drawing operation may be calculated in the same manner. When tables such as found in MACHINERY'S HANDBOOK are available, very little computation needs to be done, as all values relating to the areas and circumferences of circles can be taken directly from the tables.

Drawing a Shell for a Water Pail

In Fig. 3 is shown the lay-out for a large tapered shell, which, when completed, forms a familiar type of water pail.

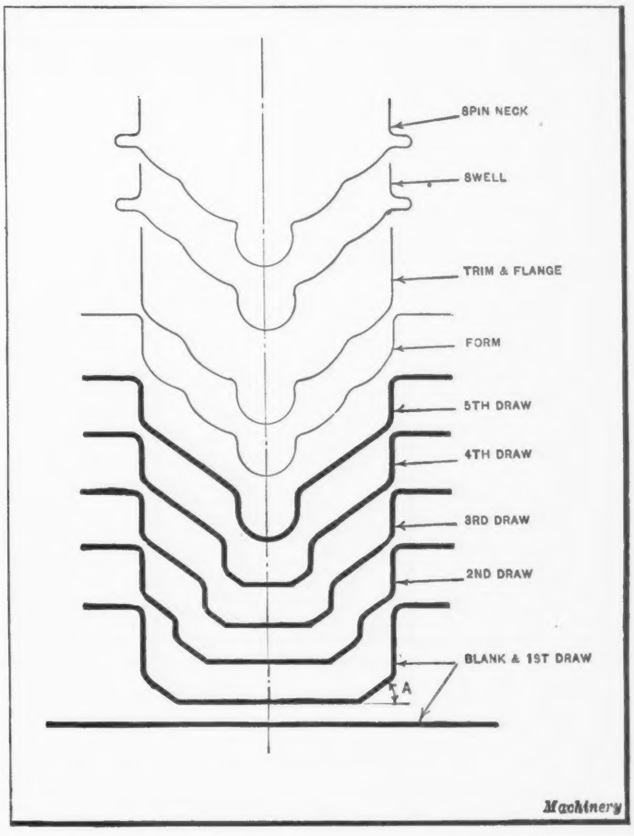


Fig. 6. Diagrams showing Successive Steps in the Formation of a Coffee Pot Cover

The heavy outline represents the completed shell. The method of drawing the shell illustrated in Fig. 3 is generally used in drawing shells that are tapered or of almost any shape other than cylindrical. Tapered and irregular shells are likely to wrinkle, particularly if drawn directly to the required shape, but this difficulty can be eliminated to a great extent if the shells produced in the intermediate operations have steps or shoulders, as indicated in the illustration.

The shape of the work after the first and second drawing operations is clearly shown. In the third operation, the shell is drawn to the shape indicated by the line *ABCD*, while in the fourth operation, it is drawn to the shape indicated by the line *EFGHD*. In other words, during the fourth drawing operation the shell is reduced in size only below point *G*, as indicated by the line *GHD*. When the drawing punch used in the final operation enters the shell, it simply stretches the metal at points *F* and *H*, and the shell leaves the press with smooth outer and inner surfaces. Of course, there is a limit to the amount a shell can be stretched, and for this reason care should be taken not to make steps, such as *GH*, too large.

Method of Drawing a Seamless Funnel

The practice of stretching the shell in the final drawing operation, as previously described, is used in producing seamless funnels of the shape indicated by the heavy lines in Fig. 4. The largest diameter of the finished funnel is 4 1/2 inches, and the bottom diameter of the spout is 5/16 inch. This funnel is made from a 7 1/2-inch blank in seven operations, the final one being stretching rather than drawing. The appearance of the shell after each step or drawing operation is clearly shown in the illustration. As a matter of interest it might be mentioned that only the first three operations and the final stretching are performed in a regular toggle press. The remaining operations are performed by redrawing dies of the inverted type, which are generally known in the industry as "combination dies." Dies of this type will be described later.

Drawing Square or Rectangular Shells

While the present article has dealt specifically with round or cylindrical shells, the principles outlined apply equally to oval shells or shells of almost any shape. In drawing shells with 90-degree corners, care must be taken to see that the corners of the dies are rounded generously for the first drawing operations. The radii of these corners can then be reduced for each successive operation.

The steps on square or rectangular work should also be made somewhat smaller. When it comes to bringing the corners out square—often this is all that can be done in one operation—the corners of the punch and die are simply made a little sharper than those of the punch and die used in the preceding operation. The method of determining the blank size for such work is, of course, different from that used in determining the size of the blank for cylindrical or round work, and it is often rather difficult to determine the proper shape of blank. No fixed rules can be given for this work; it is often necessary to make quite a number of trial blanks before the right size and shape is determined upon.

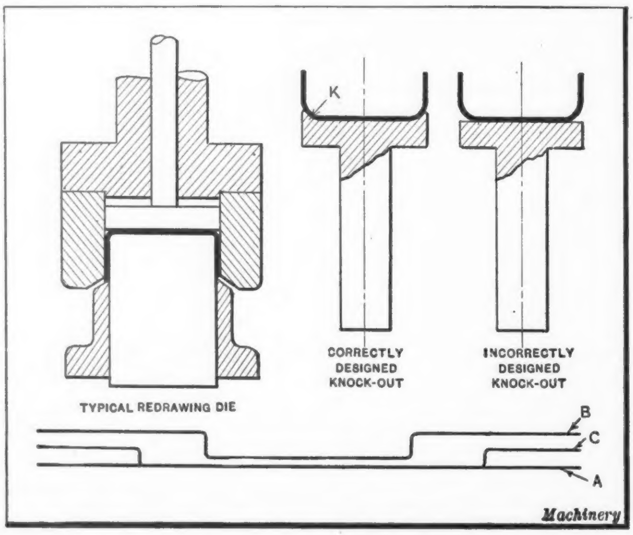


Fig. 7. Diagrams showing Points to consider in designing Drawing Dies

Combination Die for Blanking and Drawing

An article on drawing thin metal utensils of the type dealt with here would hardly be complete without a description of the combination die used for this work. The combination die is used for shells of all shapes and kinds that are not too high to be handled on a single-acting short-stroke press. In Fig. 5 is shown a cross-sectional view of a typical combination die. The die-shoe *A* is of cast iron and supports the drawing punch *B* and the blanking die *C*. These members are held in place by fillister-head screws *D*. The pressure pins *E* and the blank-holder *F* are inserted before the lower part of the die is assembled. The punch-holder *G* carries the combination blanking punch and drawing die *H* and the knock-out *J*, together with its operating rod *K*. A pin *L* is driven into rod *K* to prevent it from falling from the punch. Plate *M*, spring *N*, and stud *P* are a part of the press equipment and do not belong to the die. Spring *N* is often replaced by a rubber pressure-pad.

The part of the sectional view in Fig. 5 that lies on the left-hand side of the vertical center line shows the punch in the position it occupies just before the blanking operation is performed, while the part to the right-hand side of the center line shows the position of the punch at the end of the down stroke of the press ram. The heavy line *R* represents the stock from which the shell is blanked and drawn.

The action of this die is as follows: The stock is placed on the die *C* against gage points or stops (not shown in the illustration). As the press ram comes down, the blanking punch *H* and the die *C* cut the stock, and the blank is caught between the upper face of the draw-ring *F* and the lower face of the punch *H*. The large spring *N* (or rubber pressure-pad) which is held between plate *M* and a similar plate at the bottom of stud *P* supplies the pressure through four pins, one of which is shown at *E*, so that the blank is held firmly against punch *H*. As the ram descends, the metal is drawn over punch *B* and formed to a cup shape. On the return stroke of the ram, the pressure of spring *N* forces the blank-holder up, thus stripping the shell from punch *B*. If the shell should happen to stick in the member *H* the knock-out *J* will force it out when the ram reaches the top of its stroke.

The bevel shown on the bottom of the shell (note that the shell is drawn upside down) serves as a means of centering the work in the die used for the succeeding operation. In dies of this type the center or inner members are usually made up first. For instance, holder *F* and die *H* would be made up after the forming punch *B* had been machined and set in place. The two latter members would not be turned down on the outside to the finished size, and the die *C* would be left out altogether for the time being. Blanks of different sizes can then be drawn or formed into shells in the partially completed die. By this method it is possible to determine the exact size of blank required. After the size of the blank has been found, die *C* can be made up and the outside of punch *H* machined to size.

The die shown in Fig. 5 is used only for blanking and drawing. For redrawing, a slightly different type of punch and die is used. The blanking die *C* is, of course, omitted, and punch *H* and the upper face of blank-holder *F* are shaped to suit the bevel produced on the work in the preceding drawing operation. Blank-holder *F* must also be provided with retaining screws to prevent it from being lifted from the die as the ram ascends. All the features of the redrawing die except the latter are clearly shown in Fig. 7.

The various steps in the evolution of a coffee pot cover are shown in Fig. 6. The drawing operations are indicated by heavy lines, and the remaining finishing operations by lighter lines. All the work on this cover (except spinning the neck) was performed by combination dies. It will be noticed that the bevel at *A* is maintained until the fifth drawing operation, so that the metal will not be distorted to any great extent in forming the concentric bulges.

Troubles Encountered in Drawing Light Gage Metal

In conclusion it might be well to enumerate some of the more common troubles encountered with drawing dies and to outline briefly methods of eliminating them.

1. Continual tearing of the shells at one place. This is caused by high spots on the die or punch. Obviously the remedy for this trouble is to remove the high spots.

2. Breaking of shells at top or bottom corners. This is usually caused by attempting to form too sharp corners or corners with too small radii. However, before taking this for granted, it is well to relieve the pressure on the blank-holder slightly. If this causes wrinkles in the shell, it is certain that the first-mentioned trouble exists.

3. Difficulty in removing shells from the punch. This is caused by lack of vent holes in the punch. The omission of vent holes may also be the cause of serious trouble in operating a die provided with a metal knock-out. On the down stroke of the press, the knock-out will compress the air in the die, while on the up stroke it will form a partial vacuum that can be overcome only by the application of considerable force or pressure.

4. Trouble caused by bulging of the shell bottom. This is usually due to incorrectly designed knock-outs. Correctly and incorrectly designed knock-outs are shown in Fig. 7. At the completion of a long draw, the shell may be found to be very tight in the die and considerable pressure may be required to remove it. If the top of the knock-out is made flat as indicated in Fig. 7, the bottom of the shell will be deformed. This trouble, however, will be eliminated if the knockout is formed to fit the bottom of the shell, as indicated at *K*.

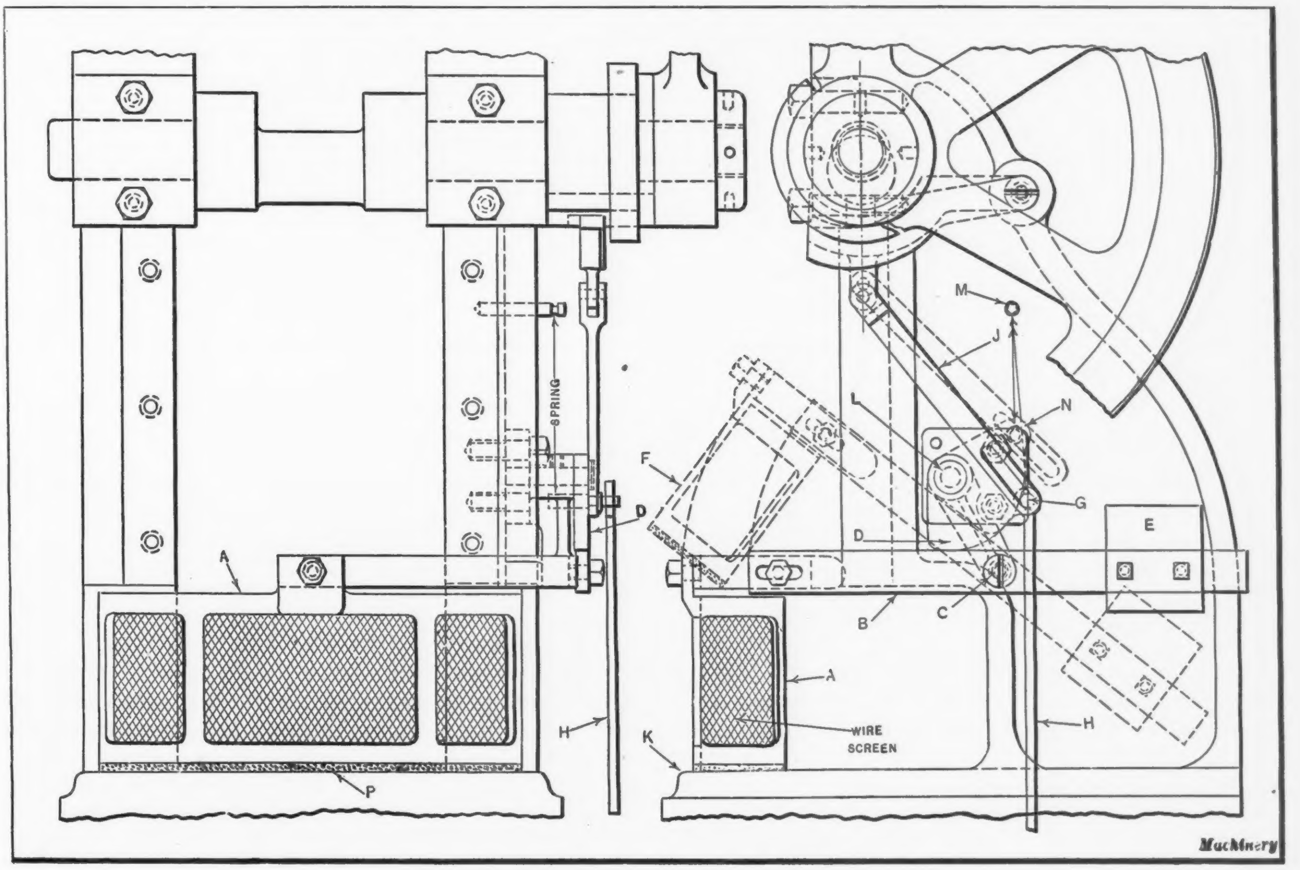
In addition to considering carefully the troubles enumerated, when designing dies, it is well to remember that too great a reduction in the size of a shell should not be attempted in one operation. Drawing metal from too large a stock area is another thing that should not be done. The view at the bottom of Fig. 7 illustrates this point. Assume, for instance, that blank *A* is 8 inches in diameter, and that a cup 3 inches in diameter by 3/8 inch deep is required to be drawn at its center. It would at first appear that it would be an easy matter to draw a form from such a shallow depression in the blank. As a matter of fact, however, it is practically impossible to do this successfully in one operation. The 3-inch cup will be drawn from too great an area of metal and it will either break or wrinkle the flange excessively. The smallest diameter that can be successfully drawn from an 8-inch plate is found by multiplying 8 inches by 0.66 which in this case equals 5.28 or about 5 3/8 inches. It will therefore be necessary, in drawing a shell to the shape shown at *B*, to perform an intermediate drawing operation which will bring the shell to the shape shown at *C*.

SAFETY GUARD FOR POWER PRESS

By S. C. HILLS

A guard designed to prevent injury to the workman's hands when operating a power press is shown in the accompanying illustration. It consists essentially of an aluminum box-shaped frame *A* attached to a lever *B* which pivots on stud *C*, and a cam *D* which actuates the lever *B*. The frame *A* is covered with a wire screen, as indicated. Lever *B* is provided with a counterweight *E* which can be adjusted to balance the frame *A*.

The dotted lines at *F* indicate the normal position of the guard when the work is being placed in the die. With the guard in this position, the press ram is at rest at the upper end of its stroke. After the work is properly located in the die, the operator trips the press or throws in the clutch by pressing down on the foot-treadle, which is connected to the pin *G* in cam *D* by means of a wire or rod *H*. The link *J* which actuates the clutch dog has a slot at its lower end which fits over pin *G*. This slot permits the treadle to be depressed far enough to allow cam *D* to force lever *B* down, so that the lower edge of guard *A* is within 1/16 inch of the bed *K* before the clutch is engaged and the ram started on its downward stroke.



Guard for protecting Press Operator's Hands

Cam *D*, which is pivoted on stud *L*, is swung around far enough by the tripping or downward movement of rod *H* to prevent the guard from rising until the ram has reached its upward position. A coil spring connected to pins *G* and *M* serves to return the cam *D* to its normal position, as indicated by the dotted lines *N*. The strips of felt *P* are placed on the lower edge of the guard *A* to prevent the operator's hands from being bruised in case the guard should come down before he removes his hands from the die.

* * *

Of the ocean-going vessels built last year throughout the world, 40 per cent were built in Great Britain and Ireland; over 20 per cent in Germany; and slightly over 10 per cent in the United States.

Metal Gear Patterns

By J. F. HINES, President, Hines Pattern & Mfg. Co., Cleveland, Ohio

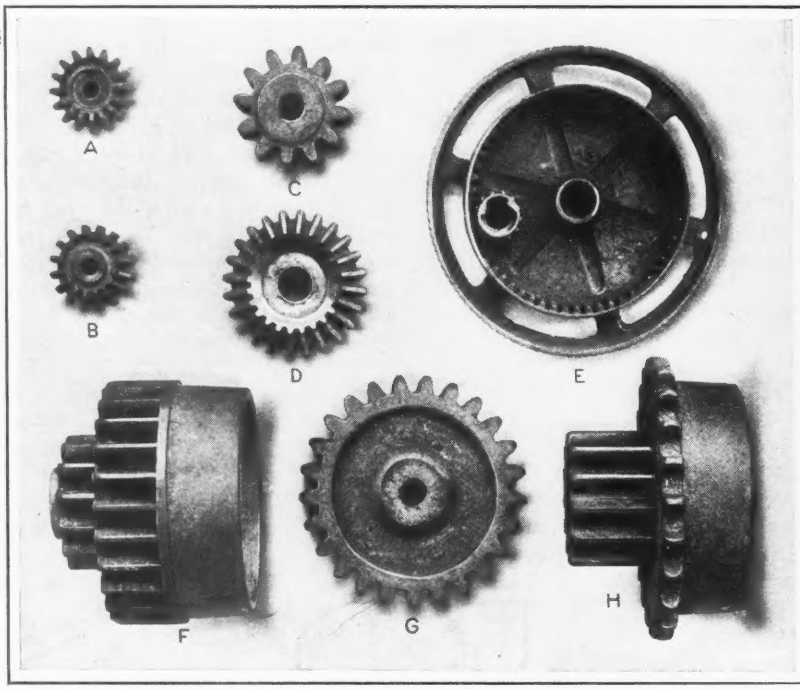


Fig. 1. Gears of Various Sizes and Types produced from Metal Patterns and completely machine-molded

METAL patterns of the type shown in Figs. 2, 3, and 4 are especially satisfactory for casting spur and bevel gears, as the gears can be produced with far more accurate teeth and uniformity than is possible by using molds produced from wood patterns. Wood patterns are made from dry lumber, and through constant use in green sand, absorb moisture and swell, often changing the dimensions of the teeth appreciably. The moisture of the patterns also tends to make them stick in the mold. In addition, wood patterns must be rapped in the sand from side to side to loosen them before removal, the result being that gears become slightly oblong and the teeth shorter and wider on one side of the gear than on the other side. Also, a draft is necessary on wood pattern teeth, which gives the teeth of the casting a slight taper, and when two gears are meshed together, the teeth contact with each other only along one side of the gears until the taper effect has been worn away.

Draft and rapping of metal gear patterns when stripped is unnecessary, because the smooth metallic surfaces of the pattern can be readily withdrawn from the mold, and so the tooth or gear dimensions are not changed. Gears ranging from 1 to 16 inches in pitch diameter have been satisfactorily produced, with teeth as small as 16 diametral pitch. These gears are suitable for road building, sugar-making, agricultural, and similar machinery, and in these classes of equipment have proved as practical as cut gears, if not more so, because the scale on the castings produces a surface that wears better than a machined surface. In addition to having the advantages of accuracy, molds can be produced much more rapidly by an unskilled workman operating a molding machine and using metal patterns than by a skilled molder using wood patterns.

An idea of the variety of gears that can be cast from metal patterns will be obtained from Fig. 1. Bevel gears *A* and *B* are used in an automobile jack, and are produced in large quantities. These gears must pass an inspection that is considered close for cast gears. They have a pitch diameter of about 1½ inches and teeth of about 14 diametral pitch. A bevel gear approximately 3 inches in pitch diameter, with teeth of 8 diametral pitch, is illustrated at *D*. A hub about 1 inch long is cast on the reverse side. Bevel gears may be cast from match plates, metal patterns that are replicas of the gears themselves, or metal patterns equipped with stripping devices. The mold is usually split at the point where the tops of the teeth join the slanting back face.

At *E* is shown a lawn-mower wheel having small internal teeth, with which meshes a small pinion that rotates the blade frame. The internal teeth and those on the pinion are about 16 diametral pitch. The somewhat more complex example shown at *H* consists of a spur pinion, chain sprocket, and pulley flange. The part is hollow from the edge of the pulley to the wall where the pinion joins the main part of the casting. This part is molded by means of the patterns shown at *A*, Fig. 2. The gear *G*, Fig. 1, has a slight hub of large diameter, and also a smaller hub on the bottom side, and is produced by means of the patterns illustrated at *B*, Fig. 2.

The patterns shown at *C*, Fig. 3, are used to produce example *F*, Fig. 1, which consists of two compound gears and a pulley flange. The inside of this part is also hollow from the edge of the pulley to a wall on the left-hand side of the large gear to which the smaller pinion is joined. There are ribs in the hollow section to support the inside of the large gear.

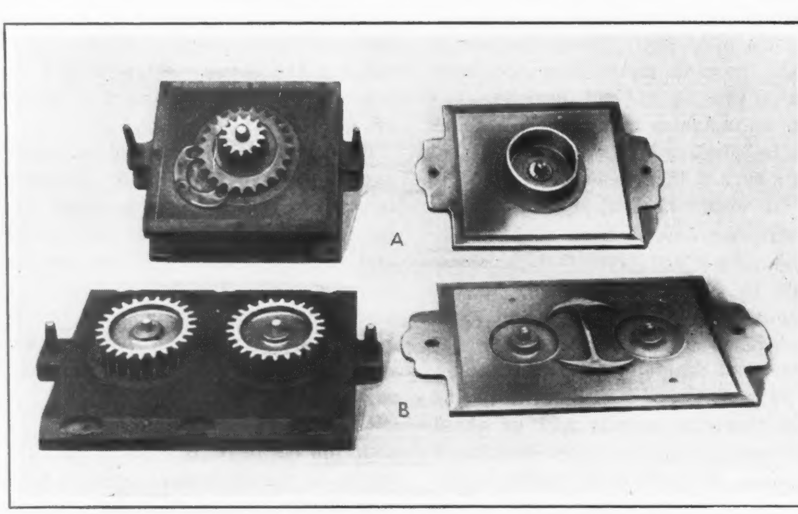


Fig. 2. Two Sets of Metal Patterns provided with Stripping Devices

The spur gear shown at *C* is produced with a hub on the reverse side,

four at a time, by means of patterns *D*, Fig. 3. This gear is about 2½ inches in diameter, and has teeth of 6 diametral pitch.

In both Figs. 2 and 3, the pattern parts at the right constitute the drag, and those at the left, the cope. The drag patterns are one-piece aluminum castings, but the cope patterns are made up of aluminum gear patterns mounted on a steel casting, and cast-steel plates with stripper inserts. In producing molds with these patterns, it is the practice to make the drag half of the mold on one machine, and the cope mold on another machine. The drag portion of the molds is relatively easy to make and the pattern can be easily withdrawn. However, the cope mold is more difficult because of the gear teeth, and a stripper plate is necessary to maintain an accurate outline of the teeth. The stripper plates in each case have internal teeth closely fitting those of the pattern.

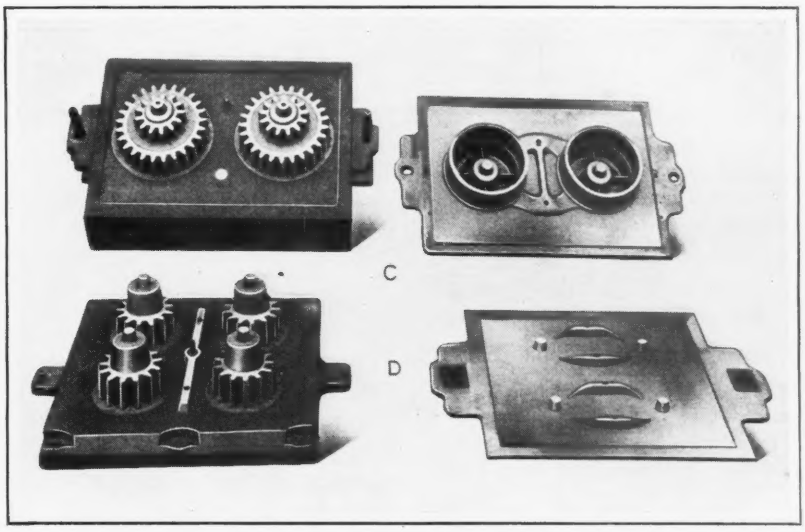


Fig. 3. Two More Metal Pattern Sets for making Gear Molds

These patterns are used on a power-operated molding machine, which has a jolt squeeze and stripping device for packing the sand solidly around the pattern surfaces and for withdrawing the pattern, through its stripper plate, at the end of the molding operation. In order that the construction of the cope patterns in Figs. 2 and 3 may be better understood, they are shown again in Fig. 4 with the stripper plates and the patterns in the positions they occupy when the patterns have been lowered, in relation to their stripper plates, so as to strip the mold. When the sand is placed in the flask, the positions of the patterns and stripper are as shown in Figs. 2 and 3. The reference letters in Fig. 4 refer to the same patterns as in the other two illustrations.

Details of Construction

Patterns *A* and *C* are of especial interest, because they are equipped with double strippers; these are necessary in one case because of the gear and sprocket, and in the second case because of the pinion and gear. In both cases the outer stripper insert is held in a steel casting of box construction, and strips the larger diameter sprocket or gear, while the inner stripper consists of a cylinder provided with teeth to match the smaller gear. This inner cylinder is also attached to the main stripper casting. The face of the cylinder serves as a pattern surface in forming one side of the large gear.

The gear patterns are made of aluminum, and are mounted on a casting beneath the stripper. This casting is equipped with guide pins which enter holes in lugs on the stripper casting, to maintain alignment between them. The design of the flasks used with the patterns is such that alignment of the drag and cope sections of the mold is assured when the sections are put together. Patterns *B* and *D* are of a simpler type, the stripper consisting of a plate casting, in which there are inserts that have teeth to fit those of the gear patterns. The latter are attached to a narrow bar casting beneath the stripper plate.

The arrangement of the gates for carrying the molten metal into the molds will be apparent by referring again to Figs. 2 and 3. In patterns *A* the metal enters the mold in the cope section, at the top of four sprocket teeth, while in patterns *B*, the gate is in the drag. Patterns *C* indicate that the metal enters in the drag at the point where the larger gear joins the pulley flange. The gate for the mold formed by patterns *D* is partly in the drag and partly in the cope. Approximately 250 molds can be produced per day from each of these patterns by two men, using a power-operated molding machine. Were wood patterns used instead, the number of molds produced by a skilled molder would only range from 60 to 80 per day.

Making the Patterns

In each example the gear patterns are separate from the casting to which they are attached, but the drag patterns are in one piece. The gear patterns are made separate so as to be more conveniently handled. The method by which these patterns were produced is as follows: Wood patterns were first made for the drag, gears, and other castings, and metal patterns then cast from these. The teeth of the gear patterns were machine cut, so as to insure uniform and accurate teeth and smooth surfaces that would facilitate stripping. Other surfaces of the gears and drag were smoothed up.

The internal teeth of the stripper plate inserts were produced by a unique method. A hole of about the same diameter as the outside of its particular gear was cut in the center of each stripper plate insert, and then this insert was placed over the gear, after which molten babbitt metal, having a considerable percentage of bronze, was poured around the gear teeth. This metal solidified firmly to the steel insert, but was forced readily from the aluminum gear pattern, with the result that the tooth outlines were produced sharp on the inserts. The top surfaces of the inserts were then smoothed by machine. The teeth on the cylindrical strippers of the double-stripper patterns were made similarly.

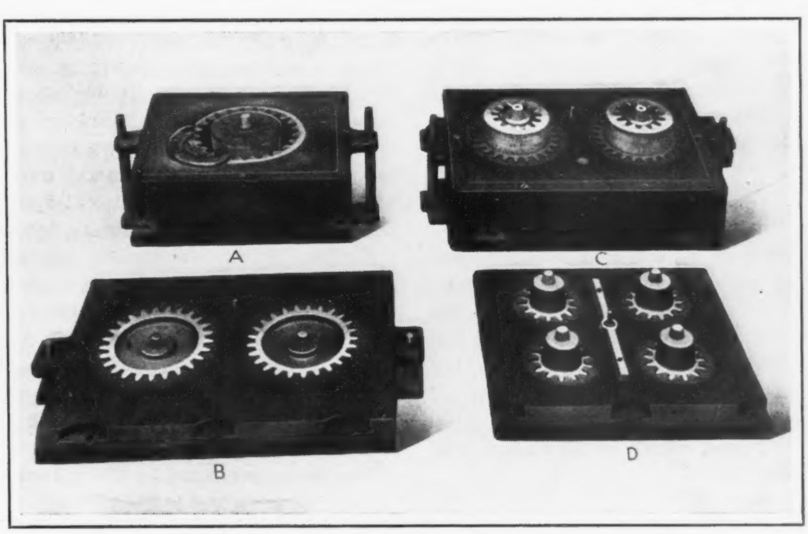


Fig. 4. Cope Patterns with the Pattern Members lowered to illustrate the Function of the Stripper Plates

MACHINE STEEL

Machine steel is a term frequently used in the machine-building industries to designate *mild steel*, or steel which has a lower carbon content than that known as *tool steel* or *crucible steel*. Machine steel may be made either by the Bessemer or the open-hearth process.

SAWDUST AS A FIRE EXTINGUISHER

Sawdust is effective for extinguishing small fires in oils and other inflammable liquids. This is due to the fact that the sawdust-particles pack together closely, and prevent the air from penetrating the surface freely enough to actively support the combustion beneath; thus sawdust smothers the flames in the same manner as a blanket, by excluding the air. Sawdust may be successfully used for extinguishing burning gasoline that has been spilled on floors or on the ground; but it is of comparatively little value in the treatment of gasoline fires in large tanks, because it is almost impossible to spread the sawdust over the entire surface before some of it sinks to the bottom, exposing the surface at these points and allowing the liquid to reignite. It is far more useful in connection with liquids such as heavy oils, lacquer, japan, and melted wax, because it floats upon the surface of fluids of this type, and blankets them quite effectually. The value of sawdust as an extinguishing agent can be considerably increased by the addition of a certain proportion of bicarbonate of soda (generally known as "baking soda"). This substance, when exposed to heat, gives off carbon dioxide gas, which materially assists in preventing the access of air. A mixture composed of 10 pounds of bicarbonate to 1 bushel of sawdust has proved satisfactory, and tests have shown that by the use of this mixture fires may be extinguished more quickly and with a smaller amount of material than when sawdust is used alone.

WEIGHT OF SUBMERGED BODY

A body submerged in water or other fluid will lose in weight an amount equal to the weight of the fluid displaced by the body. This is known as the principle of Archimedes. To illustrate, suppose the upper surface of a 10-inch cube is 20 inches below the surface of the water. The total downward pressure on the upper side of this cube will equal the area of the side multiplied by the product of the depth, in inches, to which the surface is submerged and the weight of 1 cubic inch of water. Thus, the downward pressure equals $10 \times 10 \times 20 \times 0.03617$ (weight of 1 cubic inch of water) $= 72.34$ pounds. The upward pressure on the under side equals $10 \times 10 \times 30 \times 0.03617 = 108.51$ pounds. The weight of the water displaced by the body equals $10 \times 10 \times 10 \times 0.03617 = 36.17$ pounds; and $108.51 - 72.34 = 36.17$ pounds. This excess of upward pressure explains why it is comparatively easy to lift a submerged stone or other body.

AJAX METAL

Ajax metal is a bearing metal that is composed of 77 per cent of copper, 11.5 per cent of tin, and 11.5 per cent of lead. Another bearing metal, known as *Ajax plastic bronze*, is characterized by a larger percentage of lead, the composition being 65 per cent of copper, 5 per cent of tin, and 30 per cent of lead. This latter metal is considerably cheaper than the Ajax metal itself, because the content of tin, which is the most expensive ingredient, is considerably decreased, and the content of lead, which is the cheapest of the metals used, is increased.

STUDDED CHAINS

Tests have demonstrated that the ultimate breaking strength of a chain with studded links is less than that of an unstudded chain. This is probably due to the fact that the open links of an unstudded chain collapse until the sides are approximately parallel, so that the stresses are lower than in the studded links, the sides of which are prevented from collapsing by the studs. The principal function of the stud is to prevent the chain from kinking and catching, so that it will run free from chain lockers, etc. The stud also prevents the chain from becoming rigid under heavy strains.

POWER OF WINDMILLS

The power of windmills of the same type varies approximately as the square of the wheel diameter, and as the cube of the wind velocity. This general rule is based on the theory that the intercepted area of air current varies as the square of the wheel diameter, and that the kinetic energy of the air, impinging on such an intercepted area, varies as the cube of the wind velocity. This rule is applicable within reasonable limits, but as windmills are designed to give the best efficiency in low winds, say, from 10 to 15 miles per hour, the same angle of sail will not give the same percentage of efficiency in winds of considerably higher velocity.

COARSE THREADING ATTACHMENTS

To avoid the difficulties connected with cutting threads of large lead, some lathes are equipped with a coarse screw-cutting attachment. One such arrangement is as follows: On the usual reversing shaft, and inside of the headstock, there is a sliding double gear so arranged as to be engaged with either the usual gear on the spindle or with a small pinion at the end of the cone. The gears are so proportioned that the ratio of the two engagements is as 10 to 1; that is, when engaged with the cone gear (the back-gears being thrown in), the mating gear will make ten revolutions to one of the spindle, so that, when the lathe is ordinarily geared to cut one thread per inch, it will, when driven by the cone pinion, cut one thread in ten inches. This construction dispenses with the extra strain on the reverse gears due to moving the carriage at the rapid rate that would be necessary for such a large lead, when not using an attachment. These attachments are not only used for the cutting of coarse screws, but for cutting oil grooves on cylindrical parts.

PYROMETERS FOR AUTOMATIC CONTROL

The pyrometer that automatically controls furnace temperatures is a development of the instrument that merely shows what the temperature is when it is connected with the thermo-couple circuit by some form of switch. The automatic controlling pyrometer is so arranged that the moving element of the instrument not only indicates the temperature by its position relative to a scale, but by combined mechanical and electrical apparatus, controls the temperature, within certain limits, by regulating the heat supply. The pyrometer can be set for any temperature desired within certain maximum and minimum limits. If the furnace is electrically heated, the temperature may be regulated by solenoid-operated switches, which either open and close the main circuit, or are used in conjunction with rheostats. In the case of gas or oil-fired furnaces, electrically or pneumatically operated controlling valves or dampers are employed, the opening and closing of these valves being governed by the pyrometer.

FLUXES FOR STEEL WELDING

In heating steel for welding, the tendency is for the surfaces to become oxidized, or covered with oxide of iron which forms a scale when the hot iron comes into contact with the air. If this scale is not removed, it will cause a defective weld. Wrought iron can be heated to a high enough temperature to melt this oxide so that the latter is forced out from between the surfaces by the hammer blows; but when welding machine steel, and especially tool steel, a temperature high enough to melt the oxide would burn the steel, and it is necessary to use a *flux*. This is a substance, such as sand or borax, having a melting temperature below the welding temperature of the work, and it is sprinkled upon the heated ends when they have reached about a yellow heat. The flux serves two purposes: It melts and covers the heated surfaces, thus protecting them from oxidation, and, when molten, aids in dissolving any oxide that may have formed, the oxide melting at a lower temperature when combined with the flux. Wrought iron can be welded in a clean, well-kept fire without using a flux of any kind, except when the material is very thin. The fluxes commonly used are fine, clean sand and borax. When borax is used, it will give better results if burned. This can be done by heating it in a crucible until reduced to the liquid state. It should then be poured onto a flat surface to form a sheet; when cold, it can easily be broken up and pulverized. The borax powder can be used plain or it can be mixed with an equal quantity of fine clean sand and about 25 per cent of iron (not steel) filings. For tool steel, a flux made of 1 part of sal-ammoniac and 12 parts of borax is recommended.

SPIKE-GRIPPING POWER OF WOOD

Experiments show that generally twice as much force is required to extract spikes from oak as from white or yellow pine. The spikes in the experiments mentioned were driven across the grain of the wood. When driven with the grain, the holding power is reduced at least one-half. The condition of the wood affects the gripping power. For instance, experiments have shown that the force required to draw spikes 9/16 by 9/16 inch, driven 4 1/4 inches into seasoned oak, is about 4280 pounds. The same spikes driven into unseasoned oak require 6500 pounds to draw.

ELECTROLYSIS

The corrosion of metal in the earth or in structures, due to the action of stray or leakage currents from conductors carrying electric energy, is caused by electrolysis. Electrolytic corrosion of underground structures occurs, in general, wherever current flows from the metallic structure into the earth. Many methods have been proposed or tried for reducing or eliminating damage to pipe systems and other sub-surface metallic structures due to stray earth currents from street railways. Some of these have been used widely with more or less benefit in many instances, and with apparent failure in others. There are various means by which electrolysis may be mitigated, which are applicable to the negative return of a railway system; these include the use of an alternating-current system; use of double-trolley systems; use of negative trolley; periodic reversal of trolley polarity; methods of construction and maintenance of way; grounding of tracks and negative bus; uninsulated negative feeders; insulated negative feeders without boosters; insulated negative feeders with boosters; use of three-wire systems; and location of power houses and sub-stations.

QUENCHING BATHS

Water and oil are the two quenching mediums that are most commonly used. Some concerns use brine and acid solutions, while others employ alkaline solutions, the reason for using different mediums being to fulfill the requirements of hardness, and to reduce warpage. Water is the most used quenching medium, its use only being restricted on account of its tendency to warp delicate work. The colder the water used in quenching, the harder the work will be. Water at the boiling point (212 degrees F.) is supposed to have the quenching properties of oil, while the addition of alkalies which raise the boiling point will undoubtedly give such a result. The cost of adding alkali to the water and the cost of maintaining the water at a fairly constant temperature often makes a water bath more expensive than an oil quenching medium, although water as a rule, is plentiful and cheap, and no pump or cooling device is necessary, as is the case with oil.

CHROMATIC SPEED RANGE

The "chromatic speed range" for speed-changing mechanisms is based on the square root of 2, or 1.4142. This range is simply a geometrical progression with a ratio of 1.4142, or a smaller ratio may be used, as 1.189, which is the square root of 1.4142, or the fourth root of 2. The logarithmic scale gives a number of values the adoption of which as standards in designing speed-changing mechanisms has been proposed. These values are approximately as follows: 4.75, 5.67, 6.75, 8, 9.5, 11.3, 13.5, 16, 19, 22.6, 26.9, 32, 38, 45.2, 53.8, 64, 76, 90, 108, 128, 152, 181, 215, 256, 304, 362, 430, 512. The ratio of the geometrical progression, in this case, is 1.189, although the increment of change might be any power of 1.189. With this speed range back-gear ratios of 2, 4, 8, and 16, according to the range desired, could be employed. This point is considered important, because, on some classes of machines, especially lathes, the back-gear ratio can be utilized conveniently for obtaining coarse leads.

DIFFERENTIAL OR FLOATING LEVERS

Differential levers are utilized in some mechanisms to control, by the application of a small amount of power, a much greater force, such as would be required for moving or shifting heavy parts. These levers are commonly applied to mechanisms controlling the action of parts that require adjustment or changes of position at intervals varying according to the function of the apparatus subject to control. The initial movement or force may be derived from a hand-operated lever or wheel, and the purpose of the differential or floating lever is to so control the source of power that whatever part is to be shifted or adjusted will follow the hand-controlled movements practically the same as though there were a direct mechanical connection. A floating lever is so termed because it is not attached to fixed pivots and does not have a stationary fulcrum, but is free to move bodily, or to "float" within certain limits and in accordance with the relative forces acting upon the different connections.

SPECULUM

Speculum metal is the technical name which is applied to the alloy of which telescope mirrors or reflectors are made. Its composition is two parts copper and one part tin. The addition of 1 or 2 per cent metallic arsenic gives the metal a greater compactness and a greater luster and hardness, but if such addition is made, the metal is likely to tarnish. The metal is very hard and as brittle as sealing wax.

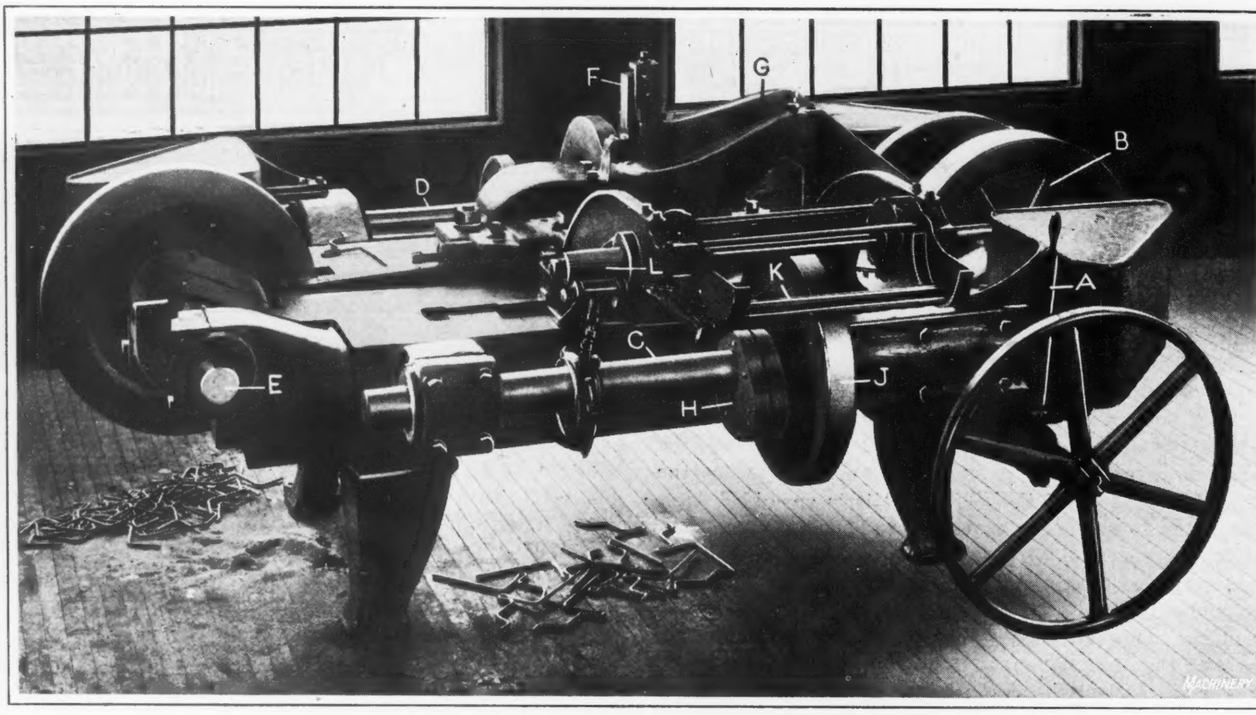


Fig. 1. Ten-ton Four-slide Wire-forming Machine designed for bending Stock up to 9/16 Inch in Diameter

Making Wrench Handles From Wire

Practice Followed in Bending Large-diameter Stock to a Variety of Shapes in a Four-slide Wire-forming Machine

THERE is a fascination in watching any automatic machine in operation, but probably no standard type is of greater interest than the four-slide wire-forming machine. In this machine lengths of wire are formed into an almost endless variety of shapes by means of dies or special devices attached to four slides, which advance consecutively toward the center of the machine. It is because of the production possibilities of this machine that paper clips, safety pins, bottle openers, cotter-pins, and similar wire articles can be made so inexpensively. In addition to this class of work, the machine is also adapted for much heavier work. At the plant of Walden-Worcester, Inc., Worcester, Mass., the wire handles of a variety of socket wrenches are bent to shape on a Baird four-slide forming machine, which weighs about ten tons and which is believed to be the largest machine of this type ever built. It has been used for bending low-carbon steel rod up to 9/16 inch in diameter. The production ranges from 10,000 to 12,000 handles per eight-hour day. These handles are designed to make it possible to reach otherwise inaccessible nuts. Set-ups used in forming several of the handles will be described in this article.

Construction of the Machine

In details of construction, this machine is similar to the Baird standard machines. It is driven from a constant-speed pulley at the rear on the right-hand side. When the driving clutch has been engaged by operating lever *A*, Fig. 1, power is delivered through a spur pinion on the driving shaft to a gear *B* on a second shaft which runs along the right-hand side of the machine directly above the driving shaft. On this second shaft there is also mounted a double cam which operates the right-hand slide to and from the center of the machine, and from this shaft power is transmitted through bevel gears to shafts *C*, *D*, and *E* at the front, rear, and left-hand sides, respectively. On each of these shafts there is a double cam for operating a slide to and from the center of the machine, similarly to the movement of the right-hand slide. These double cams consist of a tool-steel working cam *H* which is permanently attached to a "pull-back" cam *J*. The construction of the latter is such that a balanced center line action of the working cam is obtained. A roll attached to the slide comes in contact with cam *H*, thus moving the slide toward the center of the machine, while a second roller on the same stud as the first, travels in the cam path of the counterweight, causing the return of the slide.

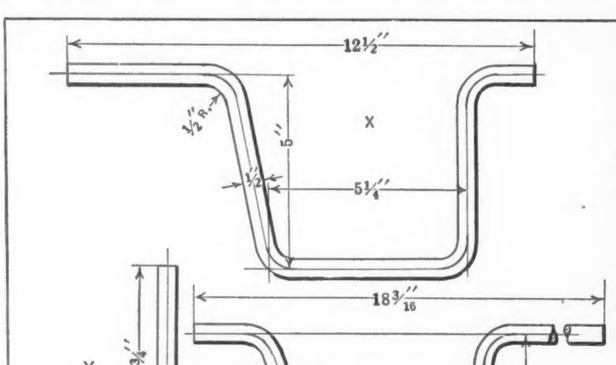


Fig. 2. Three Typical Examples of the Work done on the Wire-forming Machine

A die for forming the wrench handle is attached to each slide, and there is usually a stationary die-block at the center of the bed around which the work is bent. This block is mounted on a heavy bracket, which also supports a vertical bar *F* that is required for certain operations. This bar is removed from contact with the work after it has served its purpose. It

is raised and lowered through lever *G*, which is fulcrumed near the middle and receives motion from a cam on the right-hand shaft; this cam is separate from the other cam previously mentioned. The slide cams are so arranged that the front slide reaches the end of its stroke first, then the right-hand and left-hand slides, and finally the rear slide. This relation of movements is maintained for each job handled on this machine, and so it is not necessary to change the cam positions on their shafts for different die set-ups.

The stock is cut off to length before coming to the machine, and so it was found desirable to provide a mechanism for carrying each piece to the bending position. This mechanism is supported by two brackets on the front of the machine, which may be adjusted sidewise to suit different lengths of stock. Attached to each of these brackets is a flanged support in which the rods may be laid as shown at *K*. The operator fills this mechanism and then places the pieces, one at a time, in the slots of small upright brackets attached to conveyor chains which carry each part to the center of the machine and hold it against either the stationary die-block or the vertical bar until the dies of the front slide come in contact with the piece. As the conveyor chain must hold the piece momentarily in the bending position, there must be an intermittent motion of the chain sprockets; this is obtained through a ratchet mechanism *L* which is used to drive a shaft on which two of the chain sprockets are mounted. The ratchet mechanism is operated by means of a crank on the front camshaft and a connection. The large handwheel seen on the right-hand side is used for turning over the machine to check the die movements.

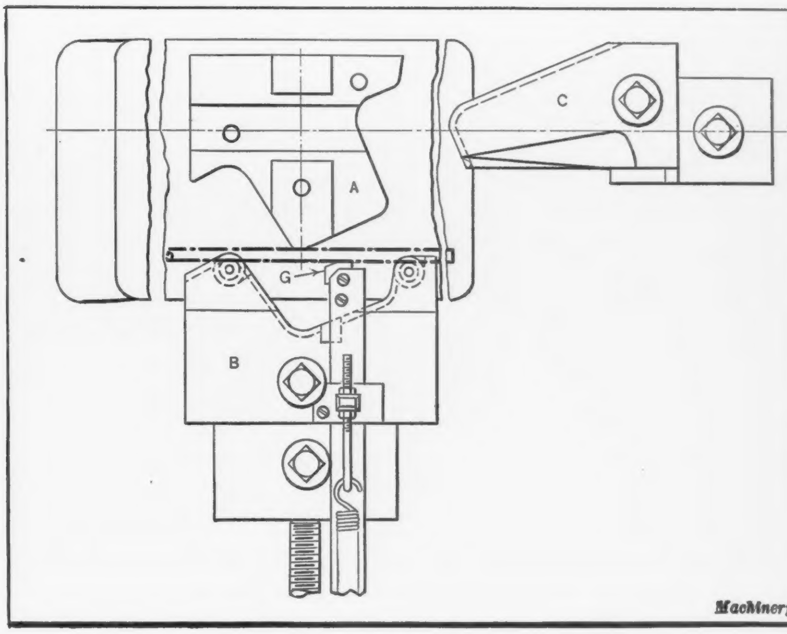


Fig. 3. Equipment provided for bending Part X, Fig. 2

Examples of Work Produced

Three typical examples of the work produced in this machine are illustrated in Fig. 2. These handles are made to different dimensions, but the stock is usually 7/16 or 1/2 inch round, 0.10 to 0.20 per cent carbon steel. The average production of each part is about 1400 per hour, which is equivalent to 23 or 24 per minute. Because the arrangement of the cams on the machine is never changed, four-bend pieces can be produced in the same time as pieces having a smaller number of bends. Before the machine was installed, each of these handles was bent by means of hand-operated devices on a bench, and some of the more intricate handles are still produced by that method. The production of example *X* by hand was about 250 pieces per hour per man; of the T-handle, *Y*, from 200 to 225 per hour; and of the double-power speed brace *Z*, less than 100 per hour.

The plain brace *X* is produced by the use of dies on only two slides, and the stationary die-block in the center of the bed. The equipment is illustrated diagrammatically in Fig. 3, which shows the slides in the open positions. It will be seen that the stationary die-block *A* is formed to suit the finished piece. The work is delivered against the front point of this block by the conveyor chains and held there until the front die *B* comes forward and brings the spring-actuated block *G* against the work. As this slide completes its forward movement two of the bends are produced, while the forward movement of die *C* on the right-hand slide forms the other two bends in the part. Fig. 4 shows these dies in the closed position with the work formed as indicated by the heavy dot-and-dash lines. It was found that the wear at the front corners of die *B* was too severe when these points were solid, and so a small tool-steel roller was provided at each of these points to reduce the friction. All dies used in these bending operations are, of course, made of tool steel. The completed work falls through the bed of the machine to the floor when the slides recede. There is a spring of about 1/4 inch between the legs of the brace when the part is released, and so this spring had to be calculated on in designing the dies. Both the rollers and the die surfaces with which the stock comes in contact are rounded to the same radius as the stock.

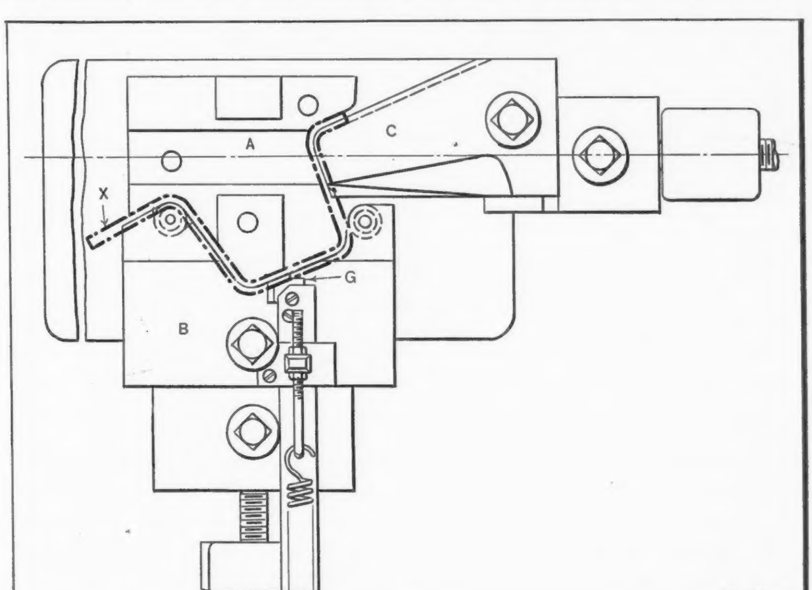


Fig. 4. Bending Dies in Fig. 3 shown in the Closed Position

Bending More Difficult Parts

The vertical bar previously mentioned is made use of in forming the T-handle shown at *Y*, Fig. 2. This bar is illustrated diagrammatically in the upper left-hand corner of Fig. 5, with the various dies in the positions occupied when the operation has been partly completed. The work is held against the bar by the conveyor chains until the front die comes in contact with it. When the right- and left-hand dies have reached approximately the positions illustrated, the work is completely supported by the dies and the bar *F*

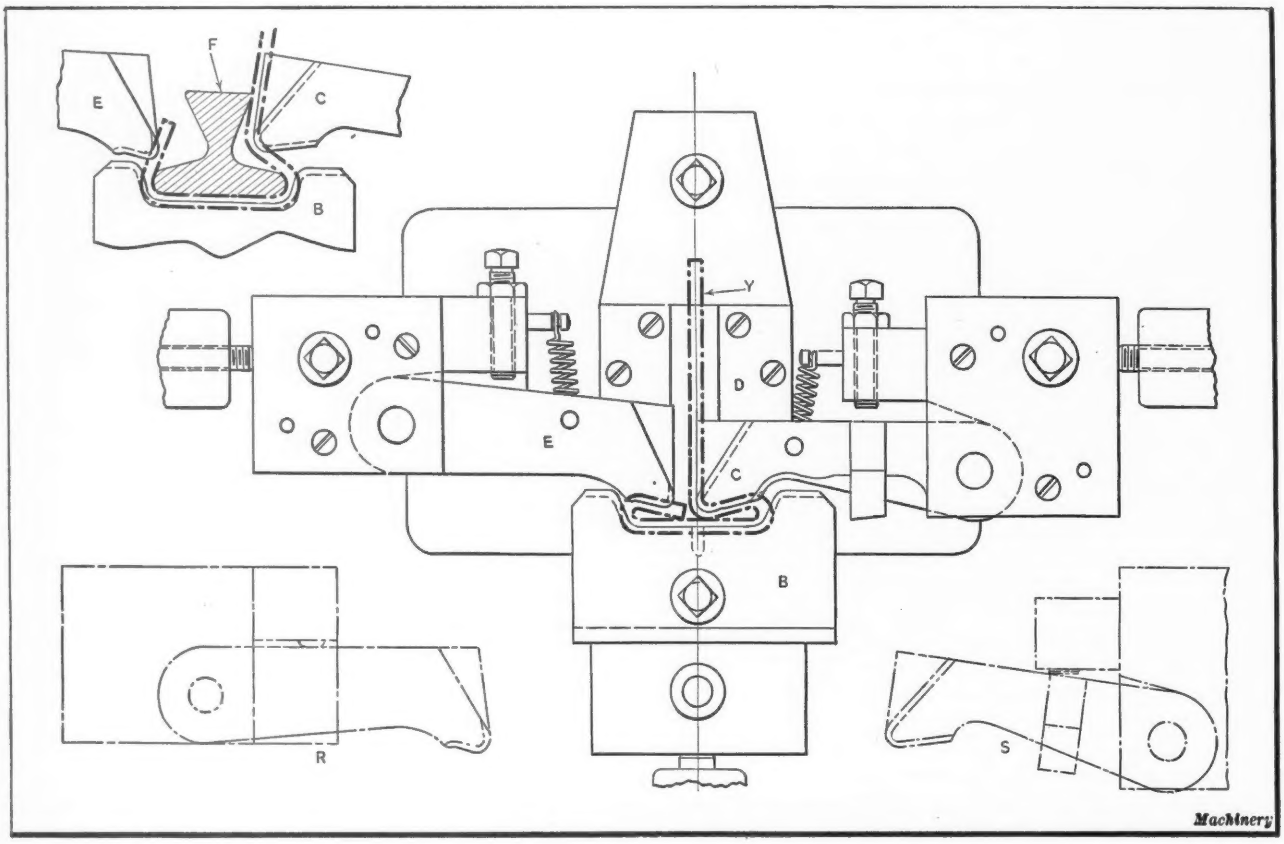


Fig. 5. An Operation in which the Four Slides and the Vertical Bar are required

is withdrawn. The dies then complete their movement toward the center of the bed, finishing the part to the form shown in the main part of the illustration.

It will be noticed that dies *C* and *E* are hinged on their respective slides, so that as they approach the center of the machine they are swung toward the front die by blocks mounted on the rear slide *D*, as the latter slide is advanced. It is this forward movement of the two side dies that "sets" the handle in the final shape. Each hinged die has a coil spring between it and the slide, which pulls the dies *E* and *C* to the positions shown at *R* and *S*, respectively, when the slides return after the operation. This set of dies is used to make T-handles of twelve different lengths on which the loop portions are of the same dimensions.

A still more intricate handle is shown at *Z*, Fig. 2, and the die equipment for this part, in Fig. 6. As in the preceding operation, the work is held against the vertical bar by the conveyor chains until the dies of the front slide *B* are sufficiently advanced to hold it there. The vertical bar *F* remains lowered until the dies have advanced to the positions illustrated at *T*; the part will then be held by the dies when the vertical bar is withdrawn.

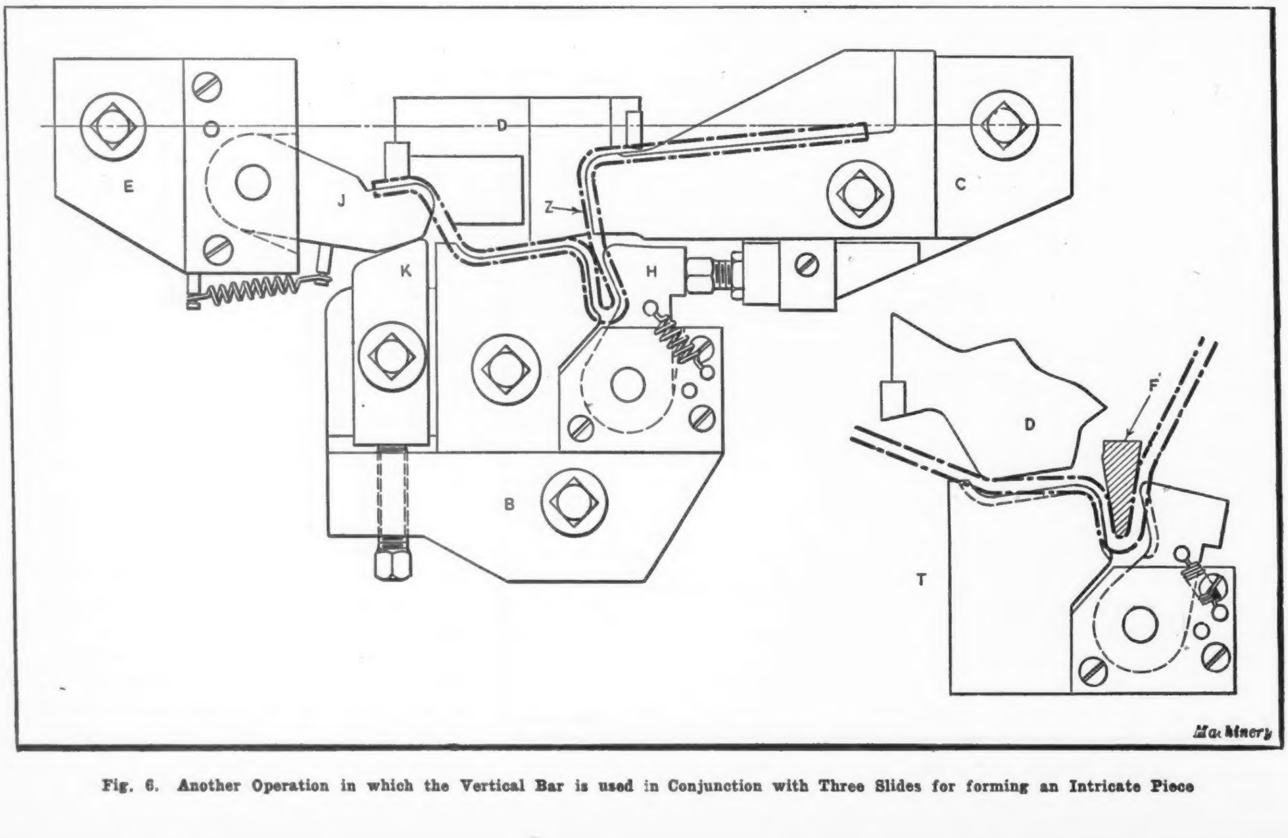


Fig. 6. Another Operation in which the Vertical Bar is used in Conjunction with Three Slides for forming an Intricate Piece

There is a stop-screw on one side of the die attached to slide *C*, which registers against the swinging link die *H* on slide *B* and pushes this link to the left to produce the slanting side of the loop in the work. The front end of the die on slide *C* enters a hollowed out portion of the die on slide *D* to produce the right-angle bend on this end of the work. The die member on slide *E* also has a link *J* which swings to the rear to produce the right-angle bend on this end. This swinging movement is effected by the link riding on a wedge-like surface of block *K* on the front slide. Both links *J* and *H* are returned to their normal positions by a coil-spring when the slides recede from the center of the bed.

* * *

FORMULA FOR CENTRIFUGAL TENSION

By W. F. SCHAPHORST

In centrifugal tension calculations, the formula commonly used requires the weight of a piece of the material 1 inch in cross-section and 1 foot long to be known, and this is a unit not given in the tables of handbooks. The square of the velocity of the part in feet per second must also be employed. This quantity, too, is generally unknown and must be obtained by a computation involving the diameter of the part and the number of revolutions per minute. In order to simplify matters, the writer has derived a formula in which the elements are more commonly known or more easily determined. The formula is as follows:

$$S = \frac{WD^2N^2}{1,690,000}$$

in which

S = centrifugal tension or stress, in pounds per square inch;
W = weight of material per cubic foot;
D = mean diameter, in feet, and
N = number of revolutions per minute.

For example, suppose that it is necessary to design a cast-iron flywheel for a steam engine, which is to have a mean rim diameter of 4 feet and is to run at 420 revolutions per minute. What tension will the cast-iron rim have to resist? The weight of cast iron is about 450 pounds per cubic foot. Substituting the various values in the formula,

$$S = \frac{450 \times 4 \times 4 \times 420 \times 420}{1,690,000} = 752 \text{ pounds per square inch}$$

According to Professor Goodman in his "Mechanics Applied to Engineering," an old millwright's rule limited the speed of cast-iron flywheels to 1 mile a minute, which is equal to 88 feet per second. This speed develops a stress of about 750 pounds per square inch. Therefore, the 752-pound stress obtained reaches the allowable limit. This allowable stress of 750 pounds per square inch may appear very small, but because of the brittleness of cast iron and the internal cooling stresses that often exist, 750 pounds per square inch is as much as can be allowed. Flywheel explosions are often disastrous.

* * *

SUCCESSFUL BUSINESSES OF THE FUTURE

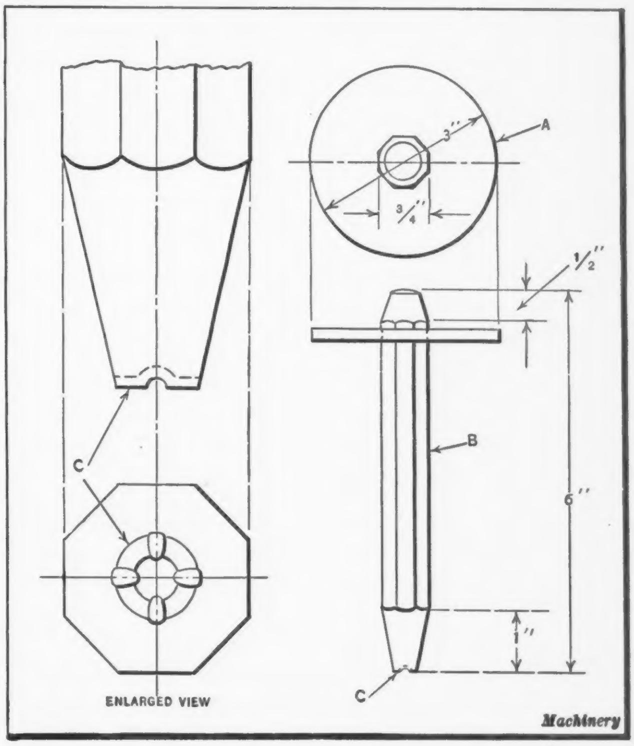
The successful businesses of the future will be those that improve the processes and reduce the costs of production; rid distribution of its present indefensible wastes; bring the price of the necessities of life lower and lower; shorten the hours of labor and enlarge the margin of leisure; eliminate periodic depressions and recurrent unemployment; limit the area of the industrial battlefield and enlarge the floor space of the council chamber; create better and better working conditions; pay higher real wages; and increase the comfort and prosperity of both their employes and their customers. These are things that the facts prove will be not optional but obligatory upon the business man who wants to succeed in a big way during the next ten or twenty years.—*Edward A. Filene, in Collier's.*

HAND RIVETING PUNCH

By ERNEST L. HOLCOMB

Occasionally a hand riveting operation has to be performed on small machine parts, because a power riveter is either not available or not suitable. When such riveting requires a fairly heavy blow, as, for example, in riveting studs or posts securely in steel plates so that a strong round head will be produced, there is danger of the workman striking his hand with the hammer. Sometimes a hollow punch is also used alternately with the riveting punch to set the work down to the shoulder of a stud or post, and this slows down production.

The punch shown in the accompanying illustration has two features that promote safety and speed. The first is a shield *A* cut from belt leather which is large enough to protect the hand, and which has a round hole in the center slightly smaller than the diameter of punch *B* so that it will stay in place on the shallow neck at the upper end of the punch. With this protection, the workman is not afraid of hitting his knuckles with the hammer, he can thus strike



Hand Riveting Punch with Leather Shield

a heavier blow and give more attention to locating the punch and holding it in position.

The second is the design of the point *C* which sets the rivet. The punch *B* is made in the ordinary manner with a half-round spot or depression in the point to form the head of the stud or post to be riveted. Octagonal tool steel is perhaps the best material for the punch, as it has sufficient stiffness and can be easily held in place. Before hardening and tempering, notches are filed across the point *C* nearly as deep as the half-round spot.

In using the punch, the work is supported firmly in a fixture on the bench or in a vise. If possible, several studs or posts should be riveted at one setting of the work. The first blow on the punch drives down four points on the head being riveted, which hold the plate firmly down on the shoulder. Then the wrist is moved to give the punch one-eighth of a turn and the second blow drives down most of the remaining portion of the head. By giving the work several blows, keeping a tight grip on the punch and turning it back and forth with the wrist movement, a good job may be done without first using a hollow punch to set the work down to the shoulder. Notching the point also provides more secure hand riveting, without so much danger of buckling the stud, as the resistance of the metal is divided.

TOOL DIVISION ORGANIZATION AND MANAGEMENT

By ELMER C. COOLEY

The essential points to be considered in developing a tool division system are dealt with in the following description of a system that is successfully employed in a number of shops engaged in interchangeable manufacture. When tools are needed for a new product, a master sheet is drawn up, which shows the nature and sequence of operations, and also contains a list of the tools required. This sheet is drawn up by the operation division, composed of competent men, familiar with tool design and shop practice. Each tool has a distinguishing number, consisting of the part number, a dash and another number, the last numbers running from 1 up.

Making the Tools

After the master sheet has been completed, an order to design and build each tool is written out, which bears the desired date of completion and the name of the department in which the tool is to be used. Copies of this order are made for the drafting department, tool-room, accounting department, and pattern shop. Record and "tickler" copies are also made out for the follow-up men. Perishable and durable tools are distinguished from each other so that the accounting department can charge the cost of perishable tools up to operating expense.

Copies of the master sheet are forwarded to the drafting-room, tool storage, production department, and the shop foremen who are to take part in the manufacture of the new product. The drafting-room officials are in constant touch with the operating division, so that ideas are exchanged and a mutual agreement reached before the designing of the tools proceeds in earnest. The personnel of the drafting-room is mixed to suit all classes of work; experienced lay-out men, and both machine and tool designers are employed for difficult jobs, while younger men do the simple tool designing and detailing. Boys are also employed for tracing and small tool work. All drawings are checked and corrected, and then approved by the chief designer. Occasionally, the foreman who is to use the tool is asked for his opinion before the work of making the tool actually begins.

A drawing-board, 30 by 42 inches in size, has been found to be about the best size for use in making the tool drawings, the paper sizes used being 8½ by 11, 11 by 17, 17 by 22, and 22 by 34—all multiples of letter sizes. An important drawing is inked in on tracing cloth. Simple tool drawings can be drawn in pencil on bond paper or vellum, and blueprinted direct at a great saving of time and expense. Blueprints of parts and tools, trade catalogues, and reference books are kept in neatly arranged files. A tracing vault and blueprint department are connected with the drafting-room.

Blueprints of completed drawings go to the follow-up division, which sends the work to the plant tool-room or some outside tool shop, orders patterns, obtains the castings, and follows the progress of the work until the tool is approved for use. The plant tool-room normally handles all new tools, but the nature of manufacturing sometimes requires large numbers of new tools to be made at short notice. In such cases, blueprints, with estimate forms attached, are sent out to jobbers or tool-building concerns, and the work awarded to the shop submitting the most favorable estimate. A requisition on the purchasing department is then made for an order to purchase the required tool or equipment. Certain classes of work, such as reamers, special drills, special milling cutters, hobs, taps, and thread gages, should be purchased at all times from companies specializing in those particular tools.

A tool inspector examines every finished tool. He should have a crib to himself, where he will be free from interruption and where he can keep his delicate measuring and testing instruments so that they will not be handled by anyone but himself. The tools approved by the inspector are sent to the tool storage crib. Small shops generally have a central tool-crib, while larger ones have a crib for each department. The tools are stored on metal shelving, in numbered bins or openings. Perishable tools are kept in two places—the working supply crib and the reserve supply crib. When the reserve approaches a given minimum, an order is given for a new supply of tools.

Enough fixtures and jigs must be kept on hand so that an accident will not cause a tie-up. Reamers and taps are short-lived, and a good supply of these tools should always be kept on hand. Milling cutters are usually ground in lots, and an allowance should be made for this, so that there will always be a number of milling cutters in reserve.

Upkeep of Tools

When it is necessary to repair a tool, the department foreman fills out a form with the number of the tool, nature of the repair, and the date on which the tool will be needed, and sends it to the tool-room with the tool. If a change in design is wanted, the tool supervisor or an authorized assistant must approve the order. When the engineering department makes a change in the design of a part that involves tool changes or requires new tools or perhaps old tools that have been stored away, the operation division issues orders for the new tools or tool changes.

The tool change notice is in triplicate, one copy being sent to the shop foreman concerned with the change, one to the drafting-room, and one to the file. This notice bears the number of the lot on which the change will go into effect. The foreman holds the notice until the proper point in production is reached, and then sends it to the tool-room with the tool. Obsolete notices are sent to the drafting-room, accounting department, and the foreman of the department concerned. The obsolete tool is either held for making repair parts (sundry department), salvaged by using parts for other tools, or made into other tools by alterations. If the tool cannot be used, it is sold or scrapped.

The systematic inspection of all tools in use is a very important factor. All small fixtures and gages are checked each time they are returned to the tool-crib. Gages that are continually in use and large fixtures that are not directly checked by gages and do not come to the crib, must be inspected at stated intervals on the floor. The tool inspector, the floor inspector, and the foreman all cooperate in this work.

The tool-room is the main factor in the upkeep problem. It should be large enough to take care of all alterations and repairs promptly and to handle the average flow of new work. If the separate departments are large enough to warrant it, they will probably each have their own cutter grinding division. The making and repairing of dies is generally handled by a department of the tool-room which specializes in this work, or by a separate tool-room.

Controlling Head

The various departments and divisions should be under the control of a tool supervisor, master mechanic, or some official who can direct and coordinate the work of these different groups. With this official are associated men who are constantly at work developing better methods, locating the cause of trouble, collecting data, etc. The departments of the plant should be divided between these assistants, so that each can concentrate his work on a definite section and become thoroughly familiar with it.

The key to the whole problem is the selection of capable men to head the various divisions. These men must have a keen sense of responsibility and carry out their work in a spirit of hearty cooperation. No system can completely eliminate errors or an occasional oversight. The men in charge must be broad enough to recognize this, and not seek to establish a maze of forms, checks, and restrictions, as this will slow up production and increase expense.

Designing Steel Castings

First of Two Articles Dealing with Various Problems Encountered in the Production of Steel Castings

By E. R. YOUNG, The Detroit Steel Casting Co., Detroit, Mich.

SUCCESS in the production of steel castings depends in a large measure on close cooperation between the designer and the foundryman. The wisdom of taking into consideration the foundryman's viewpoint and his manufacturing problems is generally recognized but perhaps less generally followed. It is not the purpose of this article, however, to discuss the broad question of cooperation, but rather to refer to some specific foundry problems and to point out the interest of the designer in these problems. The subject of design may be considered under two heads—pattern design and engineering or structural design. These two divisions overlap each other, and therefore some of the sub-topics discussed could be considered as well under one head as the other.

Pattern Design

The three main points to be considered in the pattern shop are shrinkage, finish (that is, allowance for machining), and method of molding. These three are, of course, related to one another, and in many cases are so closely related that they can only be considered by studying their combined effects.

Shrinkage is probably the most important and the most troublesome problem that confronts the foundryman when castings are required to be made true to pattern. Shrinkage may be defined as the contraction or the difference in the volume occupied by the molten metal which fills out the impression left by the pattern in the mold, and the volume occupied by the metal after it has cooled to room temperature. A contraction or shrinkage of 1/4 inch per foot in all directions is considered normal, but there are many cases where castings do not shrink normally, and it is these cases that make the subject more interesting and difficult to handle.

Some of the factors controlling the amount of shrinkage that takes place when a casting cools are temperature; chemical composition; type of mold used, that is, whether a dry sand (baked) mold or a green sand (skin-dried or undried) mold is used; location and nature of cores (whether dry sand or green sand); location of ribs and cross-members in the castings; and size and shape of the casting itself. The shrinkage of an individual casting is dependent in many cases on the combined effect of several of these factors. In discussing the effect of the various factors, it is convenient to consider them under the headings of causes of less than normal shrinkage and causes of excessive shrinkage.

Effect of Dry Sand and Green Sand Molds on Shrinkage

In general, anything that tends to prevent full contraction from taking place will result, of course, in less than normal shrinkage. Here we have the primary distinction between a dry sand and a green sand mold as regards shrinkage. The baked dry sand mold is rigid and does not give readily, while the green sand mold offers much less resistance. Steps can be taken in some cases to make the baked mold pliable or collapsible by building a hollow or soft center, but still it will always be more rigid than an unbaked mold. It is not possible to state exactly the difference in actual shrinkage between the two types of molds. Other things being equal, full shrinkage probably occurs in a green sand mold, and something less than full shrinkage in a dry sand mold.

Let us consider a simple case, such, for example, as the casting with two parallel projecting parts shown in Fig. 1. When this casting cools, the two faces *A* and *B* are brought toward each other by the contraction of the metal, and this movement is prevented to a greater or less degree by the resistance to compression of the molding material between them. In such a case a dry sand mold will permit less movement than a green sand mold. The question that naturally arises is: What happens if this movement is prevented? The tendency is for the metal to pull apart and the casting to emerge cracked if the metal offers less resistance than the sand mold. Such shrinkage cracks are prevented by the use of fillets, brackets, chills, collapsible molds and cores, and other devices, but as all this pertains more closely to the subject of foundry practice it will be passed by with the remark that the foundryman must be continually on the alert to prevent shrinkage cracks.

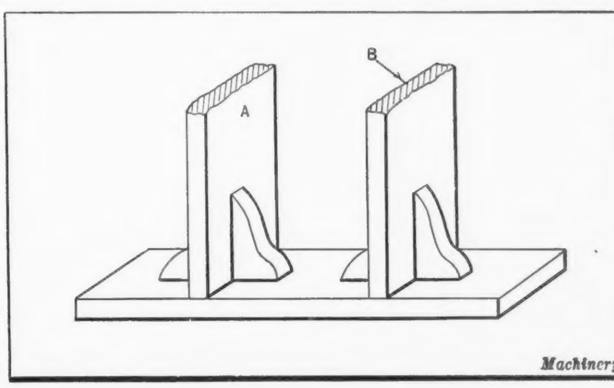


Fig. 1. Casting with Projecting Parts that offer Resistance to Shrinkage

When castings do not shrink fully and the occurrence of shrinkage cracks is prevented, the result is a state of internal stress in the casting. These internal stresses are relieved by annealing, and this is one reason why it is desirable to anneal all castings. However, such stresses are not always as great as might be expected, since many large castings are successfully used unannealed, the advisability of so doing depending on the design of the casting and the service required of it. It is probable that full cubical contraction or shrinkage occurs in all cases, and that when the longitudinal shrinkage is less than normal, the shrinkage across the breadth and thickness of a section is correspondingly greater, thus making up the full cubical shrinkage. This would leave the casting with less internal stress than if full cubical contraction did not take place.

If a casting has no parts that project into the sand to interfere with the contraction of the metal, as, for instance, a plain slab or bar, the type of mold used will have practically no effect on shrinkage, but as a matter of fact, we always have the projecting gates and risers to consider. It is the general practice to use the dry sand mold for all castings that require considerable machining before being put to use. Therefore, it is desirable for the foundry to know what purpose a casting is to serve.

It is also desirable for the designer to bear in mind that castings with projecting arms or parts should have good sized fillets at the base of these projecting parts, and the cross-section of such castings should not be too light; in some cases they should be provided with strengthening ribs

if these are not already present in the design, as in Fig. 1. When the castings are to be machined, a dry sand mold will be used to insure clean metal on the machined surfaces. The shrinkage strains, in this case, will, of course, be greater than if green sand is used.

Cores

The effects that green sand and dry sand cores have on shrinkage are similar to those of green sand and dry sand molds, but the conditions are more complex, as the castings become more intricate. In some cases, a pattern may be designed to produce its own core so that the mold really contains the equivalent of a core. What has previously been said regarding molds would apply to such cores. We may also have green sand and dry sand cores or both in either green sand or dry sand molds, or in a combination of the two, one part dried and one undried.

Whenever we have a box-like dry sand core in a casting we can look for unusual shrinkage conditions. Full contraction will not take place over such a core, regardless of what occurs in the other part of the casting, and in some cases no shrinkage at all occurs over the core, with the result that this part of the casting is distinctly over-size. In the box-like casting with one side open as shown in Fig. 2, the shrinkage along the dimension *A* taken across the sides will be very little, while the dimension *A* at the top will show greater shrinkage; the sides will therefore flare out and the casting emerge warped, unless suitable precautions are taken.

Warping of castings is a troublesome problem in itself. Like shrinkage cracks and cavities, this is a problem that concerns the foundryman to a greater degree than the designer, and therefore the subject will not be expanded in this article. It should be stated, however, that the amount of warping depends on the size and shape of the castings, and on the method of molding, as well as on the shrinkage characteristics. One effective means of combating warping in such cases as the box-like shape under discussion is to distort or modify the pattern or core-box so as to compensate for the warping that occurs. Of course, this is a "cut-and-try" method, and can be readily applied only in production work and not on small quantities or single jobs. A simpler method that is effective on castings shaped like a yoke or bail is to join the open ends of the casting with a tie-bar which can be removed in the cleaning room. The concern of the designer in determining the probable amount of warping is pointed out later in this article in connection with structural design.

Rib Design

If there are cross-members or ribs in a box-like casting, a peculiar shrinkage condition will obtain. Full shrinkage will be likely to occur at the ribbed section so that the dimensions of the casting at this point will be less than those taken on either side of it. This results in a low spot at *B*, Fig. 2, which may not clean up even in a machined casting. In any casting, the point of intersection of two ribs shrinks more than the surrounding metal, so that a low spot

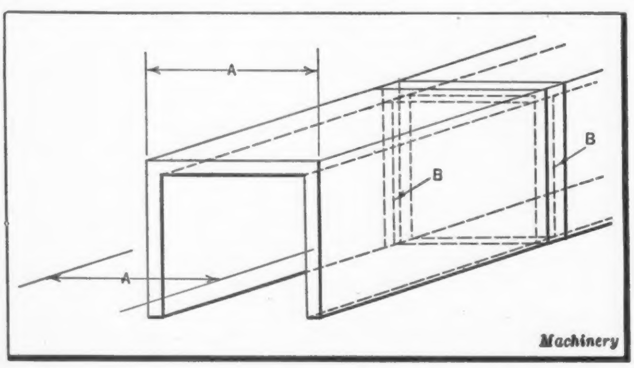


Fig. 2. Box-like Casting with Open Side and Internal Ribs which prevent Uniform Shrinkage

is usually formed. These are conditions that cannot be totally avoided by the designer. They are described, however, to emphasize the fact that there are certain types of castings that are difficult to produce, and to point out the type of construction to be avoided when feasible.

Foundries usually contrive to make almost anything that is designed. If the casting is so designed that certain parts remain hot longer than others, shrinkage cracks are likely to occur in these parts, which are weaker in the hot, partly fluid condition than the surrounding parts that have already solidified. The foundryman is then obliged to equalize the cooling, that is, to make the places where there is a heavier section cool as quickly as the other parts.

Size and Shape of Castings

Large castings with perhaps 4 feet or more as their greatest dimensions do not shrink along the large dimensions at the rate of 1/4 inch per foot, but more nearly at the rate of 3/16 inch per foot. This holds true regardless of the shape of the casting, and is not accounted for by other conditions, such as large hard cores which interfere with full shrinkage. However, full shrinkage occurs along the smaller dimensions of the same casting.

A casting in the shape of a large ring which has a large body of sand in the center does not show full shrinkage across its diameter, but considerably less than full shrinkage. On such a casting the difference in shrinkage in a green sand and a dry sand mold is very pronounced. In the case of a large ring of approximately 9 1/2 feet outside and 7 1/2 feet inside diameter, the difference between the inside diameter of a casting made in a dry sand mold and the inside diameter of a casting made in a green sand mold, from the same pattern, was found to be very close to 3/4

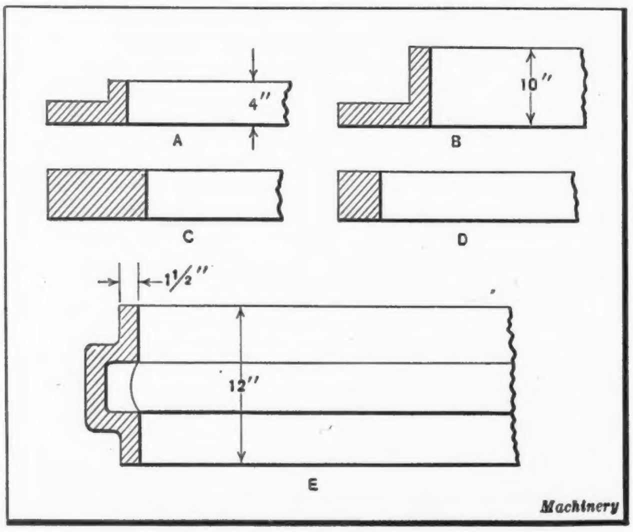


Fig. 3. Diagrams showing Effect of Cross-sectional Shape of Ring on the Amount of Shrinkage

inch. This is equivalent to a difference in shrinkage per foot of more than 3/32 inch.

The shrinkage of such castings is affected by the dimensions of their cross-section. If a ring has a deep face as shown at *B*, Fig. 3, the shrinkage will be less than if it has a shallow face, as shown at *A*, because there is a greater body of enclosed sand to resist shrinkage with a deep face than with a shallow one. On the other hand, a thicker face or heavy section through the face as at *C*, will result in a greater amount of shrinkage than a light section *D*, presumably because there is a greater mass of metal exerting a compressive force against the enclosed sand. For a large ring, such as the usual design of riding ring for a dryer, which has a finished section 1 1/2 inches thick as indicated at *E*, the shrinkage is about 1/8 inch per foot.

When large castings or those presenting unusual shrinkage conditions are made repeatedly, the shrinkage occurring on the various parts of the casting is determined by experi-

ence, and the patterns are constructed according to these shrinkages. This is done both by the foundries that specialize in certain kinds of work and by manufacturers whose engineers have learned the peculiarities of the castings used in their product. For example, on certain parts of locomotive frame patterns a shrinkage allowance of 1/10 inch per foot is used.

It might be well to emphasize the fact that full shrinkage occurs along the smaller dimensions of large castings even though it does not occur on the over-all dimensions. In some cases it is desirable to use 1/8 or 3/16 inch per foot shrinkage in laying out some dimensions of a pattern, and ¼ inch on other dimensions. In the casting shown in the upper view of Fig. 4, the over-all shrinkage will probably be about ⅛ inch per foot, and the dimension *A* should be laid out according to that shrinkage (with ample finish on both sides of *B*), while the dimensions *B* should be laid out with an allowance for shrinkage of ¼ inch per foot.

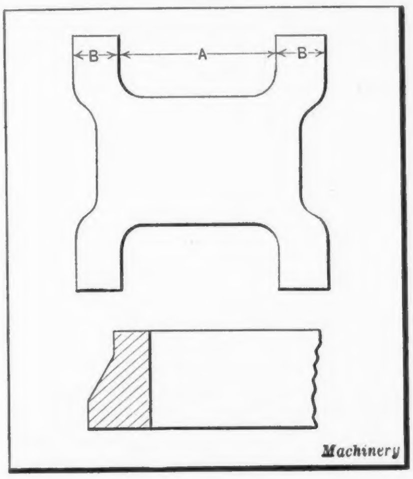


Fig. 4. Castings that require Generous Shrinkage Allowances

Excessive shrinkage is of much less frequent occurrence than less than normal shrinkage.

The temperature at which the metal is poured into the mold has an appreciable effect on the amount of shrinkage that occurs. The hotter the metal, the greater the shrinkage. In pouring small, thin-sectioned castings, it is necessary that the metal have good fluidity, and this is attained by bringing the steel to a high temperature before tapping—about 3000 degrees F. as compared to 2650 to 2800 degrees F. for pouring the heavier sectioned castings. The usual shrinkage on small light work with the lightest thinnest sections from 1/8 inch up in thickness, is 5/16 inch per foot, even though the casting may be 3 or 4 feet long.

Chemical Composition

The chemical composition of the metal also has some effect on shrinkage, though this is not so important as some of the other factors discussed. The amount of shrinkage increases noticeably as the silicon content increases, which is exactly opposite to the effect of silicon on cast iron.

Some foundrymen state that shrinkage decreases as the carbon content increases, basing their statement on the observation that some castings which crack when poured with low carbon steel can be cast without cracks when poured with higher carbon steel. But this may be due to the effect of temperature on the shrinkage, as the higher melting point of low carbon steel requires a higher temperature for successful pouring than the higher carbon steel.

Finish Allowances

This brings us to the subject of finish or machining allowances. The machining allowance or finish is the amount of excess metal which is provided in order to permit the removal of all irregularities and surface defects by the finishing cut. On small castings an allowance of ⅛ inch for finish should be sufficient, but on larger castings this should be increased to ¼ inch. A casting 36 inches or more in length should have an allowance of ¼ inch for finishing, and castings 8 to 12 feet in length that require an absolutely true surface should have an allowance of ½ inch.

When it is difficult to determine just how much shrinkage will occur on certain dimensions, the patternmaker can insure that the casting will "clean up" by making judicious finish allowances. Take, for example, a large ring casting of heavy section, such as shown in the lower view of Fig. 4, having an outside diameter of 11 feet and an inside diameter of 10 feet, both being finished dimensions. Let us suppose that the patternmaker uses 3/16 inch per foot shrinkage as the maximum for which he must provide, and 3/8 inch finish all around, and that the actual shrinkage is found to be only 1/8 inch per foot. The difference between 3/16 inch and 1/8 inch shrinkage per foot is 1/16 inch per foot, making the 11-foot outside diameter 11/16 inch over size and the 10-foot inside diameter 5/8 inch over size. The result of the outside diameter being 11/16 inch over size is 11/32 inch extra stock to be machined off in addition to the 3/8 inch finish, or nearly 3/4 inch on each side. But on the inside the result of the diameter being 5/8 inch over size is to reduce the stock allowed for finishing from 3/8 inch per side to only 1/16 inch per side. This means that the casting in all probability would not "clean up" inside and would be scrapped or have to be built up by welding.

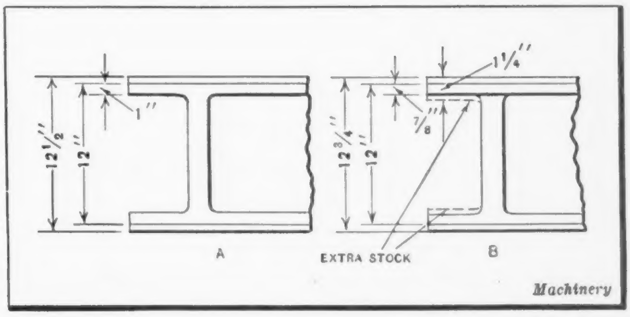


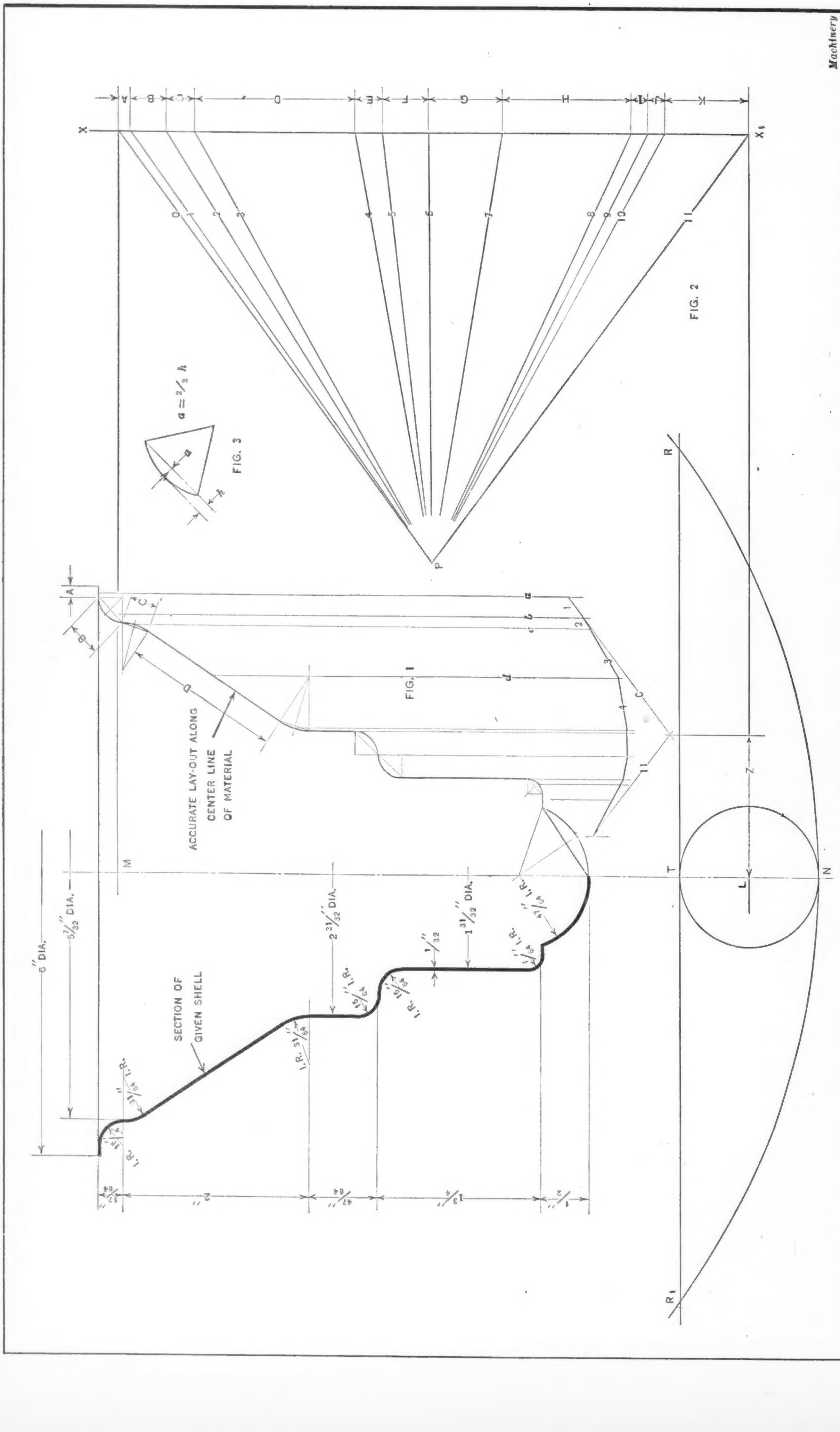
Fig. 5. Type of Casting that may have Less than Normal Shrinkage

Now, if the patternmaker, in his uncertainty regarding what the actual shrinkage will be, allows for a shrinkage of 3/16 inch, but adds extra stock inside for finish, say from 1/4 to 3/8 inch additional, or a total finish allowance inside of 5/8 to 3/4 inch per side, he would be sure that the casting would "clean up" regardless of the shrinkage, and the only result would be some excess metal to remove either inside or outside, depending on whether the shrinkage is greater or less than anticipated. In a case like this, where the probability is that the shrinkage will be less than the amount allowed for, it might be well to allow something less than the full ⅜ inch finish outside, but the important thing is to add sufficient stock for finish inside to cover the possible discrepancy in the shrinkage.

Another good illustration of this point is a casting having two parallel plates with a cored section between them, such as the bridge block shown in the view at *A*, Fig. 5. The required over-all height of this casting is 12 inches between the finished surfaces of the plates, and the minimum thickness of the plates themselves is 1 inch. The shrinkage along the 12-inch dimension in this case may be practically negligible. The view at *B* shows the result when such is the case and ¼ inch per foot shrinkage as well as ¼ inch finish is allowed for; the plates in this case will be only ⅞ inch thick when the casting has been machined to the 12-inch dimension.

In this case some extra stock should be added to the inside surfaces of the plates. If full shrinkage should occur and excess stock has been added, the result will be merely that the plates will be somewhat thicker than the minimum dimension. In some bridge shops it is standard practice to use a common or standard rule in laying out the distance between plates, that is, to make no shrinkage allowance whatever along this dimension.

It should be clearly understood that in all such cases the foundry is not to be held responsible for extra weight or extra machining. It is responsible for good, usable castings, and if the design is such that precautions involving extra cost to the customer are necessary to insure good castings, the customer should be prepared to bear this expense.



Figs. 1, 2 and 3. Diagrams illustrating Method of finding Blank Diameter of Drawn Shell

METHOD FOR DETERMINING BLANK DIAMETERS

By RONALD L. WAKELEE

The method for determining blank diameters of drawn shells described in this article is simple to apply and gives results that agree more closely with the proven blank size than any of the commonly used methods that the writer has tried out during his ten years of experience in die work. The method is applicable to any cylindrical shell, and can be memorized after a few trials. The slight shortening of the lengths of the various segments, and the consequent diminishing of the blank diameter, resulting from taking chordal measurements with the dividers instead of calculating the full length of the arc segments compensates to some extent for the stretching of the material while drawing.

The example used to illustrate the method is the same as the one given in the article "Blank Diameters for Drawn Shells" which appeared in January, 1923, MACHINERY on page 349, so that the method here given can be easily compared with the one presented previously. In the method given in this article, it is necessary to carry out the following operations:

1. Make an accurate lay-out of the shell section along the center line of the material, as shown in Fig. 1 of the accompanying illustration, and divide it into segments, *A*, *B*, *C*, etc.
2. Drop lines from the center of gravity* of each segment, and letter these lines *a*, *b*, *c*, etc.
3. Draw line XX_1 (Fig. 2), and space off on this line the developed length of each segment *A*, *B*, *C*, etc., using dividers for this purpose. (Set at 1/16 inch in this case.)
4. Draw lines to the ends of each segment from any point, *P*, and number them 0, 1, 2, etc.
5. Starting at any point on line *a*, draw a line that is parallel to line 1, Fig. 2, between lines *a* and *b*, Fig. 1. Also draw a line parallel to line 2 between lines *b* and *c*, from the point of intersection of lines 1 and *b*. Next draw a parallel to line 3 between *c* and *d*. This process is continued until a line parallel to line 11, Fig. 2, has been drawn in Fig. 1. Line 11 and line 0 intersect, as shown in Fig. 1. Line 0 in Fig. 1 is, of course, drawn parallel to line 0 in Fig. 2, and passes through the starting point on line *a*.
6. Drop a line from the point of intersection of lines 0 and 11 to the point of intersection of a line drawn at right angles to line XX_1 from point X_1.
7. With *L* as a center, draw a circle through the midpoint of line *Z* and make *LM* equal to XX_1. Next, with *M* as a center and with a radius *MN*, draw an arc which intersects a tangent drawn through point *T* parallel to LX_1 at the points *R* and R_1. The length RR_1 is the required blank diameter which, in the given case, is equal to 8 61/64 inches.

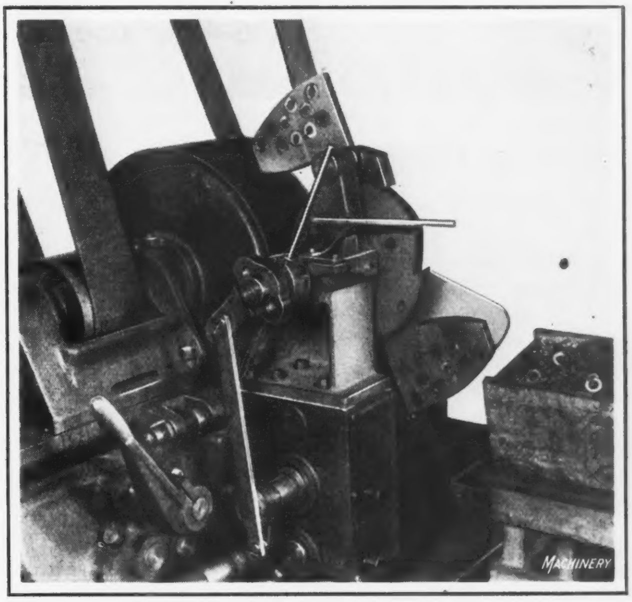
* * *

GRINDING THE ENDS OF COIL SPRINGS

An attachment for use in grinding the ends of coil springs square with the axis is shown in the accompanying illustration. This was designed for use on the No. 220 automatic grinder built by the Badger Tool Co., Beloit, Wis. On this machine there are two opposing wheels, so that if a spring is fed between them while held in such a position that the ends are parallel to the wheel faces, it is possible to grind the ends of the spring square with its axis.

To accomplish this, an attachment is provided having two arms, in the ends of which there are a number of holes into which the springs are inserted so that they project slightly on each side of the arm. The arm is then fed in between the grinding wheels, and in this way the ends of the springs are ground. When the arm is in position, the wheels gradually close in upon the springs, which are then compressed slightly, after which the wheels come to a stop in their feeding motion. The tension of the springs, however, produces sufficient pressure so that the grinding continues until the wheels are moved away from the spring. About one minute is usually allowed for the grinding operation.

In order to prevent grooves from being worn in the grinding wheels, the spring holder or arm is reciprocated during the grinding process, the movement having an extent of about one inch. In order to produce a good finish, it is preferable to grind the springs wet. This also keeps the springs cool, so that they can be easily handled when they are to be taken out of the holder. This type of attachment allows springs to be ground ranging in diameter from 1/2 inch to 2 inches, and up to 8 inches in length. As an example of the speed with which springs can be ground, it may be mentioned that in one case a valve spring 1 inch in diameter, made from 3/32 inch wire, was ground at the rate of from 1000 to 1200 springs an hour, each holder being arranged to take 20 springs at a time. It is evident, of course, that different diameters and lengths of springs will require different holders.



Attachment for grinding Coil Springs

When a batch of springs have been ground between the wheels, a lever is pulled back which releases an index-pin, permitting the fixture to be turned over to a position where the springs can be taken out and a new batch put in place. While this is being done, the springs in the opposite end of the holder are being ground. The wheels cannot be fed into the springs until the fixture is in the right grinding position with the index-pin in place. A bracket in the rear is provided with a cam which produces the oscillating motion during the grinding, but the arrangement is such that when the fixture is indexed around and comes to a vertical position, it is supported so that it will not slide down. Before the operator indexes the machine, he steps on a foot-treadle, which operates the grinding wheels, bringing them apart. After the other end of the holder is in place between the wheels, he removes the foot from the treadle and weights bring the wheels together against the pressure of the springs.

* * *

The engineering phases of the design, operation, and maintenance of motor vehicles used in commercial transportation will be dealt with in a two-day meeting of the Society of Automotive Engineers, to be held in the Engineering Societies Building, 29 W. 39th St., New York City, September 24 and 25. Three distinct types of commercial vehicles will be discussed—the motor truck, the motor bus, and the rail-car.

*The center of gravity of a circular arc is on the perpendicular bisector of its chord at a distance a equal to 2/3 h (to be estimated by the eye) see Fig. 3. For irregular curved sections, the outline is divided into short segments which are treated as arcs. The center of gravity of a straight line is, of course, at its mid-point.

Increasing Production by Power Conveyors

Conveyor Installations that Have Proved Their Economy in a Plant Manufacturing Small Parts

By CHARLES O. HERB

WHEN power conveyors for metal-working plants are mentioned, one immediately thinks of the large plants of the automobile industry, where keen competition has necessitated the universal use of conveyors of this type. However, it would be wrong to suppose that the power conveyor is uneconomical in medium-sized shops or shops manufacturing a varied line of products. This statement is substantiated by the experience of the Edison Electric Appliance Co., Inc., Chicago, Ill., who, by the installation of eight conveyors, has expedited production on the jobs handled in this way from 50 to 100 per cent. The conveyor system has also resulted in a marked economy in floor space. This concern has about 2000 employes, and manufactures electric ranges, heaters, toasters, irons, etc.

Before installing these conveyors, the factory employes were paid on a piece-work basis, but since their installation the bonus system has been used. The employes in all departments earn, on an average, about 25 per cent bonus, and so the new method of paying is satisfactory to them because it means larger wages, and to the firm, because production is speeded up. A few of the conveyors in this plant will be described in the following.

Japanning Conveyor

Conveyors are generally used for the transportation or assembly of work, but in some instances, they are also employed for carrying work through an operation, and in this plant there are conveyors for japanning and for cleaning and drying work before and after electroplating operations. The japanning conveyor is about 156 feet long and is designed for handling a maximum load of about 16 tons of parts per hour.

The work is successively cleaned in chemical, dried, dipped in japan, allowed to drip, and then baked, as it is carried

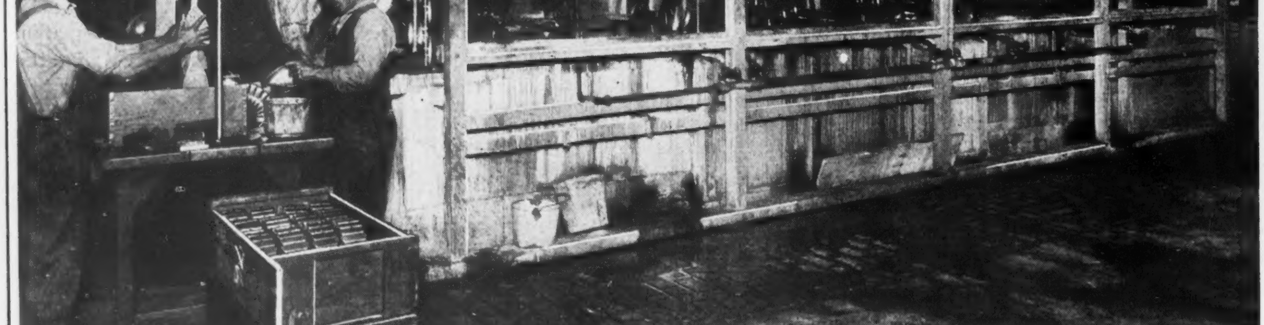


Fig. 1. Conveyor Installation for cleaning Work before nickel-plating

along by the conveyor. Link-Belt chains and sprockets are used throughout, the work being attached to hooks which are hung from 2-inch seamless steel tubes, placed every 3½ feet along the chain. These tubes move at a speed of about 2 feet per minute, and the length of time the work stops for each operation has been arranged to suit. One hour and thirty-one minutes is required for a part to travel from the loading to the unloading end. The installation of this conveyor has more than doubled the department capacity, and has about halved the labor cost. In addition, the space required for japanning has been greatly reduced. The structure consists mainly of angle-irons, the chain sliding along on the legs of the angle-irons between the different sprockets.

The arrangement of the conveyor is illustrated diagrammatically in Fig. 2. The work is loaded at the right-hand end at *A*, where the work-carrying tubes move in a horizontal plane for 2½ minutes. Then it is raised high enough to clear the chemical tank at *B*, into which it is next dropped for about 1.8 minutes to insure thorough cleaning. The chemical solution in this "roll-wash" is about 90 per cent benzine, and has been found especially satisfactory because of the fact that any liquid remaining on the parts quickly evaporates in the drying process. Provision had to be made to guard against serious consequences, should the cleaner catch fire. This was done by placing a 50-gallon fire-extinguisher at one side of the tank; the lowered head of the extinguisher is connected by means of a chain to a fusible link, located centrally above the tank. In case of a fire, the fusible link will melt and release the chain, thus permitting the extinguisher head to swing upward and force a stream of extinguishing chemical over the entire surface of the burning cleaner.

After being lifted out of the chemical wash, the work is dropped into a compartment at *C*, which contains steam pipes for drying it; then it is raised into compartment *D*, which is a hot air dryer. Compartment *C* was originally designed for a steam rinse, but this was found unnecessary because the parts are satisfactorily cleaned in the cleaning tank. The time of travel through compartment *C* is 1 minute, and through dryer *D*, 4.3 minutes. From the hot air dryer the work is dropped into a japanning tank at *E*, where it remains for 1 minute. As two grades of japan are used for different parts, it was found desirable to have tanks and provide a means for quickly removing one tank and substituting the other. For this reason the tanks are equipped with wheels and run on a track which extends from both sides of the conveyor. A pump keeps the japan agitated in the tanks, and filters are also provided.

From the japanning tank the work is carried over drip pans at *F*, where it is left for 13.3 minutes, and is then raised into the baking furnace at *G*, which is about 65 feet long and 7 feet square. The temperature of the furnace ranges from 475 to 550 degrees F., depending on the quality of the japan, and the time of conveying the work through the furnace is about 29.3 minutes. The furnace is of the hot-air gas-heated type, and is equipped with a blower which draws the hot air toward the end of the furnace that the work enters, and exhausts it into an overhead compartment where it is used to preheat the fresh air coming into the furnace. In order to conserve space, the furnace was built on the roof of the building, which arrangement gives a clear storage space 14 feet high and 56 feet in length underneath. The conveyor is driven by a 5-horsepower motor, running at 1800 revolutions per minute, the drive being through a Foote Bros. speed transformer with a reduction of 72 to 1. The design of the conveyor is such that the parts going down from high places almost compensate for raising parts at other points. From the left-hand end of the furnace the parts are carried down to the unloading station at *H*; it takes 3.4 minutes for the work-carrying tubes to pass this point. The conveyor chain and tubes return on an overhead track to the loading position.

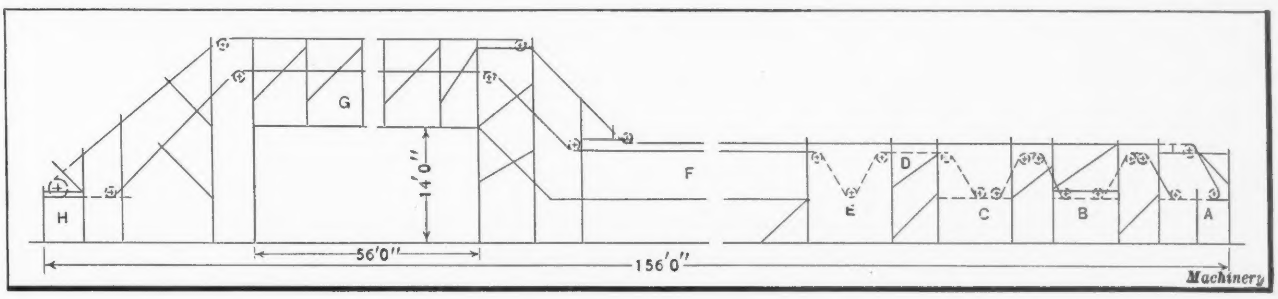


Fig. 2. Diagrammatic View of the 16-ton Japanning Conveyor

Conveyors for Cleaning Work before Nickel-plating, and Rinsing and Drying Afterward

In order to deposit by electroplating one metal upon another in a smooth firmly adhering layer, it is essential that the surfaces be cleaned of all oil, grease, or foreign matter beforehand. Many of the products of this plant, such as electric irons, are given a high-nickel or brass finish, and the thorough cleaning of the parts before the operation is accomplished by means of the conveyor shown in Fig. 1, which successively dips the parts into cleaning and rinsing tanks. This conveyor also consists of Link-Belt chains and sprockets with round bars connected to the two chains at intervals of about 2 feet. The parts to be cleaned are attached either to hooks or to special fixtures having a hook at the upper end for conveniently hanging them on the rods. As seen in the illustration, the parts are hung on the bars at the left-hand end and are carried immediately into a tank, where they receive a combined chemical and electric cleaning. While in this tank, electric current is passed through the bars on which the work is suspended. After the parts are raised from the tank, they are lowered into a clean water wash, and are then successively dipped into a chemical solution, a cold-water rinse, a caustic soda wash, and a final cold water rinse.

It will be seen that the conveyor chains are returned to the starting end over the top of the conveyor, and that the drive is furnished from a motor also located on top of the unit. This motor is of ½ horsepower capacity, and drives the conveyor through worm-reduction gearing and a chain and sprockets at a speed of about 6 feet per minute. It will be noted that there is a large hood above the chemical and electric tank, through which the fumes are drawn by a blower fan. The over-all length of this unit is about 25 feet, and approximately 10,000 small parts are cleaned in an eight-hour day.

As the parts are taken from the nickel-plating tank, they are rinsed and dried by means of a conveyor illustrated in Fig. 3, which somewhat resembles the conveyor shown in Fig. 1. Here, again, the parts are carried on hooks hung on bars of the conveyor. They are first dipped into a tank of water, raised, then dipped into a hot-water rinse, after which they are carried through a drying compartment at the right-hand end. In this compartment the parts are carried to a considerable height, the arrangement being such that the heat is confined as it rises, and so naturally the hottest point of the compartment is at the top, where the

heat and gases are exhausted through a flue. The heat is obtained by means of coils of steam pipe and a gas "booster." This conveyor is also driven by a ½-horsepower motor, and has an operating speed of about 6 feet per minute. Before this installation was made, the many small parts nickel-plated by the company were dipped and wiped by hand; the efficiency of the conveyor over that method is at once apparent. From the time the parts are hung on the conveyor for cleaning before electroplating, they are not removed from the fixtures or hooks until they come from the last conveyor mentioned.

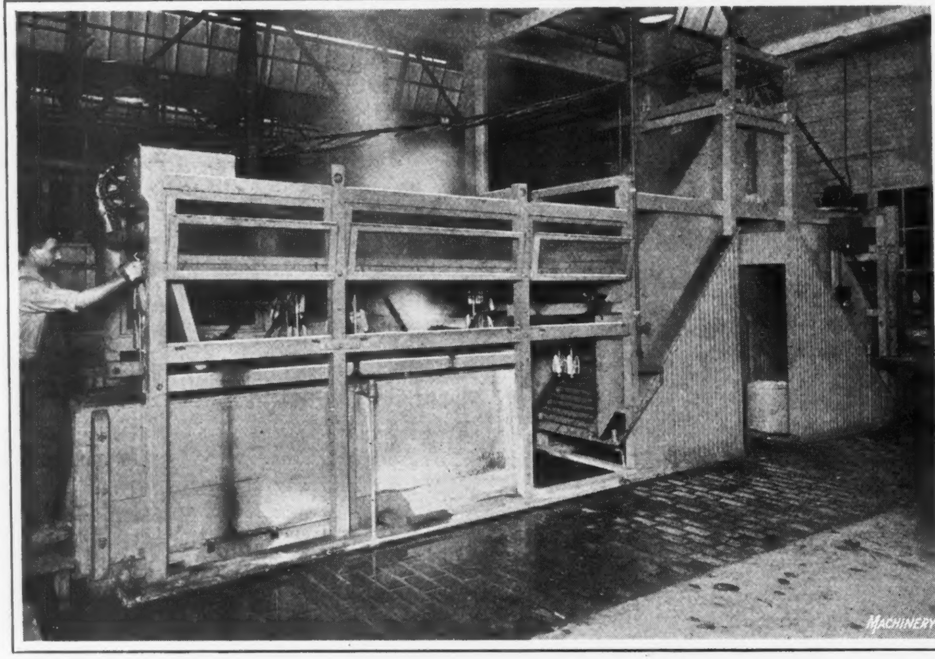


Fig. 3. An Installation for washing, rinsing, and drying the Parts after nickel-plating

Assembly Conveyors

Conveyors are used in assembling both the large products of the company, such as electric ranges, and the small products, such as electric toasters and irons. The conveyor for the range assembly is approximately 150 feet long and 27 inches wide, and is of the apron type with wood blocks about 6 inches wide. In order to resist wear, the blocks are made of birch. This conveyor is illustrated in Fig. 4. The range bodies are placed on the conveyor at the starting end, and as they are carried along, the door, hinges, switchboard, top, and all other parts are assembled. Then the range is tested electrically and completely crated, reaching the unloading end ready for immediate shipment. This conveyor is driven by a 2-horsepower motor located at the unloading end, so that the apron blocks are pulled rather than pushed. The blocks are attached to Palmer-Bee link chains, and travel at about 1½ feet per minute, a rate which is maintained for all assembly conveyors in use throughout this plant.

Another assembly conveyor of the apron type is shown in Fig. 5. This is employed for assembling electric irons, and on each apron block are fastened wood strips to coincide with the outline of the bottom of the iron. Assembly of the different parts is facilitated by seating the iron within the strips. The first step of assembling consists of inserting two screws into the sole or bottom plate, by laying the part on the flat top of a simple screw-driving mechanism, putting an isinglass insulation on top of the sole plate and a pressure plate on top of that, and finally driving the screws in from the bottom. This unit is then laid on the conveyor, and as it is carried along, the top, handle bracket, handle, plug receptacle, etc., are assembled, the various parts being taken from bins along the conveyor line. After the assembly is completed, but while the iron is still on the conveyor, it is given both physical and electrical inspections, cleaned by wiping with alcohol, and packed in cartons. The unloading end is so arranged that the cartons drop automatically from the conveyor and slide to a sealing machine in the shipping department, where a dozen cartons are packed in larger corrugated pasteboard cases and sealed. An accurate watch is kept on production by having each package strike a counting mechanism as it drops from the conveyor.

Fig. 4. Apron Conveyor on which Electric Ranges are completely assembled, crated, and delivered into the Shipping Department

Before this conveyor was installed, there was continual congestion in this department, because of the many benches and trucks necessary. This conveyor is driven by a 3-horsepower motor through worm and spur gearing having a reduction of 72 to 1. There is a metal strip on each side of the apron blocks and on the top and bottom. These strips slide on the metal frame of the conveyor, and are lubricated by means of flat strips at the loading and unloading ends.

Conveyors of the belt type are also used; the one employed for assembling toasters is shown in the heading illustration. A similar one is used for assembling coffee

percolators and heaters. All these parts are not only assembled on a conveyor, but also cleaned, examined physically and electrically, packed, and delivered into the shipping room. By delivering directly into the shipping room, trucking is reduced to a minimum. Conveyors of this design are equipped with a combination rubber and fabric belt, of a width to suit the part handled. The belt is driven by a 12-inch wood pulley at the unloading end, connected to a ½-horsepower motor.

* * *

DETROIT SECTION MEETING OF S. A. E.

Balancing of engine and chassis parts is now being effected in production by some car builders to a degree deemed impracticable less than five years ago. Crankshafts are being balanced both statically and dynamically within very close limits. Pistons, rings and connecting-rod assemblies are being carefully selected and grouped in engines with regard to their relative weights. Even the clutch and the propeller-shaft assemblies are being tested to eliminate disagreeable vibration due to unbalance. These and many other interesting facts were brought out at a recent meeting of the Detroit section of the Society of Automotive Engineers, when production aspects of the vibration problem were discussed in a symposium of six papers. These were presented by representative engineers of the Packard Motor Car Co., the Cadillac Motor Car Co., the Wyman-Gordon Co., and the Northway Motor & Mfg. Co. In connection with the presentation of these papers, W. R. McDonough of the Gisholt Machine Co., Madison, Wis., gave a brief illustrated talk describing the balancing machine made by his company. This machine was demonstrated after the adjournment of the meeting.

* * *

Employes of the General Electric Co. are owners of, or are paying on the installment plan for, a total of $11,458,260 in G-E Employee's Securities Corporation bonds. This was announced after a tabulation had been made of the subscriptions to the third offering of these bonds, which amounted to $5,339,800. These bonds pay 8 per cent as long as the owner remains with the General Electric Co.

THE SWEDISH MACHINERY INDUSTRY

With the paralysis of the German machinery industry, according to a statement in a recent issue of *Commerce Reports*, Sweden has come to the foreground more prominently than ever as an exporter of industrial machinery. The sales of American industrial machinery in northern Europe during the past year have been unsatisfactory, the difficulties being attributed mainly to continued economic and industrial depression and strong German competition. These causes are gradually becoming of less consequence, although the depression is still felt, and the machinery building and consuming industries have increased their activities materially and are looking forward to a gradual expansion throughout the present year.

German competition has become less serious due to Germany's increasing financial difficulties. In heavy machinery Germany has always had a strong position in the Scandinavian markets, owing to her proximity and consequent lower freight charges. This advantage she will maintain unless her industrial organization becomes more completely disrupted.

The exports from Sweden of the most important products of the machine-building industries, including electric motors and generators, separators, internal combustion engines, steam and water turbines, ball bearings, agricultural machinery, and telephone apparatus, amounted to approximately $14,000,000 in 1923, an increase of about 20 per cent over the exports in 1922 and in 1913. In 1922, as in 1913, about one-third of Sweden's machinery exports went to Russia, and in both years about 15 per cent went to non-European countries. Since the war, Russian purchases from Sweden have consisted mainly of locomotives. Twenty per cent of the exports are taken by Norway, Denmark, and Finland—Norway being the largest single purchaser in the industrial machinery field.

* * *

According to a *Commerce Report*, a shipment of about 200 tons of agricultural machinery, consisting of cream separators, plows, and other agricultural implements, has been shipped from Czecho-Slovakia to southern Russia.

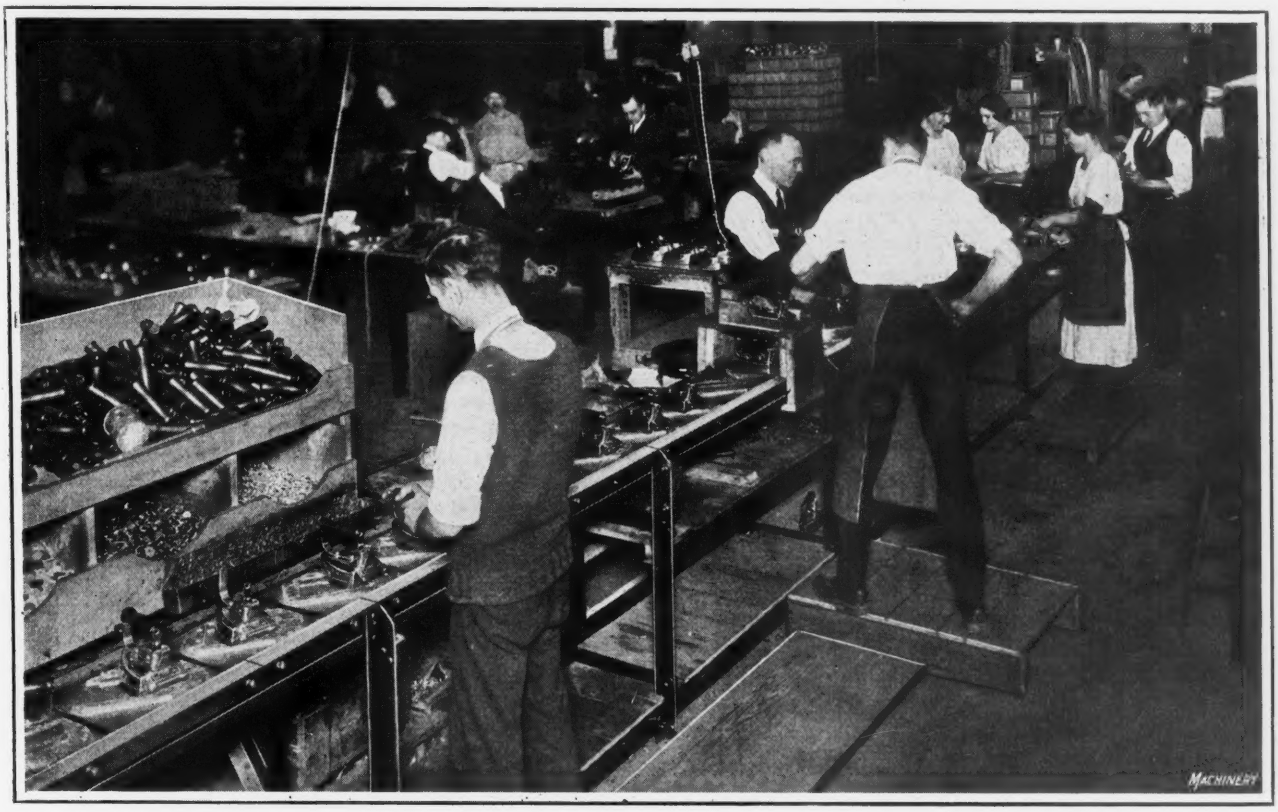


Fig. 5. Another Conveyor of the Apron Type on which Electric Irons are assembled, packed and delivered to a Sealing Machine

Notes and Comment on Engineering Topics

There are now about 600 broadcasting radio stations in the United States, and altogether about 22,000 radio sending apparatuses on ship and land, according to the records of the Department of Commerce.

It is reported that a new patent law will shortly be introduced in Italy, which will provide for a uniform term of duration of patents of fifteen years from the date of application. All documents will be required to be in the Italian language, and renewal fees will become due within a month of the application.

In an analysis of the cost of operating trans-Atlantic liners, recently published in *Marine Engineering and Shipping Age*, it is stated that the most economical size ship is one about 600 feet long and of moderate speed. Larger vessels do not give as satisfactory a return on the investment, and it is likely to be many years before 900- and 1000-foot ships will be economical in operation.

The British Engineering Standards Association has recently published Bulletin No. 166, which contains a standard list of 170 terms and definitions used in connection with radio communications, and which forms one section of a complete list of terms and definitions used in electrical engineering generally. The list may be obtained at 1s. 2d. from Messrs. Crosby, Lockwood & Son, 7 Stationers' Hall Court, London, E.C. 4, England.

Aluminum alloy wheels for auto buses have been used experimentally by the London General Omnibus Co. These wheels weigh only one-half as much as standard steel wheels and have given exceptionally satisfactory results. The wheels now in service have covered over 30,000 miles. The economical advantage of the aluminum wheel is that the scrap value is about two-thirds of the original cost of the casting. It also reduces the unsprung weight of the vehicle and minimizes road destruction.

The Bureau of Mines has produced a number of educational motion picture films depicting the mining, preparation, and utilization of various mineral materials. In co-operation with industrial concerns, nearly one hundred such films have been made. Besides those relating directly to mining and metallurgy, films have been prepared showing such industrial processes as the manufacture of oxygen, methods in automobile manufacture, methods of compressing air, and the making of fire-clay refractories. Those who wish to obtain permission to use these films for educational purposes should communicate with the Bureau of Mines, Department of the Interior, Washington, D. C.

The record for the highest accuracy in watches has again been broken at the official tests recently completed at Teddington, England, where the highest place up to the present time was awarded to a watch made by Paul Ditisheim, of Switzerland. A theoretically perfect watch is considered equal to 100 points. The watch now holding the record gained 97 points. It is estimated by experts that on account of variations in humidity and atmospheric pressure and also because of inaccuracies in the recording instruments, no watch could ever gain more than 98.5 points. The achievement of 97 points is, therefore, considered very remarkable. The highest record in 1903 was reached by the same maker with 94.9 points. For more than twenty-one years he has held the record in competition with more than 18,000 chronometers tested in international trials.

One of the noteworthy developments that have taken place in Japan following the recent disaster has been the large-scale introduction of more modern labor-saving devices, such as automobile trucks, steam shovels, and other mechanical devices designed to take the place of human labor. The necessity for quick action and the lack of manual labor were largely responsible for this move. Contrary to popular opinion, Japanese day labor has never been plentiful or, in late years, cheap. The speed and efficiency with which the debris was cleared away has been an eye-opener to the Japanese. The effects of this innovation should be far-reaching, and may cut the Gordian knot of high wages and high production costs in industry, at the same time opening a market for our specialized highly automatic machinery.

Underground battery charging stations for charging storage battery locomotives are found in more and more mines as the use of storage battery locomotives is being extended, according to a paper recently issued by the Bureau of Mines. The location of such stations should preferably be near the shaft entrance, where a supply of fresh air ample for ventilation can be obtained. Batteries should never be recharged in a gaseous part of the mine. The best installation includes spur tracks which can be isolated from the main return for each locomotive, thereby avoiding danger of grounding the outfit while charging. To transmit power for charging, a heavy insulated cable is used between the charging panel and the locomotive. In many installations an automatic cut-out is provided which shuts off the power when charging is complete. Each locomotive should be provided with an ampere-hour meter. Open lights should never be allowed in a charging station, also care should be taken that metallic material of any kind is not laid or allowed to fall across the cells and thereby short-circuit them.

The recording of strains produced in bridges by trains or motor trucks passing over them has been made possible by a new electric telemeter or strain gage developed at the Bureau of Standards of the Department of Commerce. The gage has two points which are clamped to the part of the bridge truss on which the measurements are to be made, and two stacks of carbon disks. A change of load on the truss causes a change in the distance between these points, and this is so arranged as to cause a change in the pressure on the carbon stacks and a consequent change in their resistance. The electrical apparatus for measuring and recording these changes can be placed at any convenient point, being connected to the gage by three wires, and the apparatus can be made to record very rapid changes. The recording apparatus can be used with several gages at once, as many as twelve gages having been used with a single recorder. The problem of recording these instantaneous strains has never before been successfully solved, although their values were known to be high. A heavy motor truck running over a rough floor, or a locomotive traveling at high speed, may cause a strain on a bridge truss very much greater than would be caused by the same machine when not in motion.

Attachments for Standard Machines

By ALBERT A. DOWD

MANY times it is possible to design an attachment for a standard machine in such a way that work of a special nature may be manufactured on it either automatically or nearly so. When this is possible, the designer should carefully consider machines on the market that can be adapted to the purpose. Special machines would need to be designed entirely for the work in question, and the cost of building, in addition to the cost of design, is an important item. Not only is there an advantage in using a standard machine from the viewpoint of first cost, but such a machine can also often be adapted for special work by the use of attachments which can later be removed without impairing the usefulness of the machine for regular work. An engine lathe, for example, may be made to give greatly increased production if provided with special toolholders, forming attachments, or other special devices.

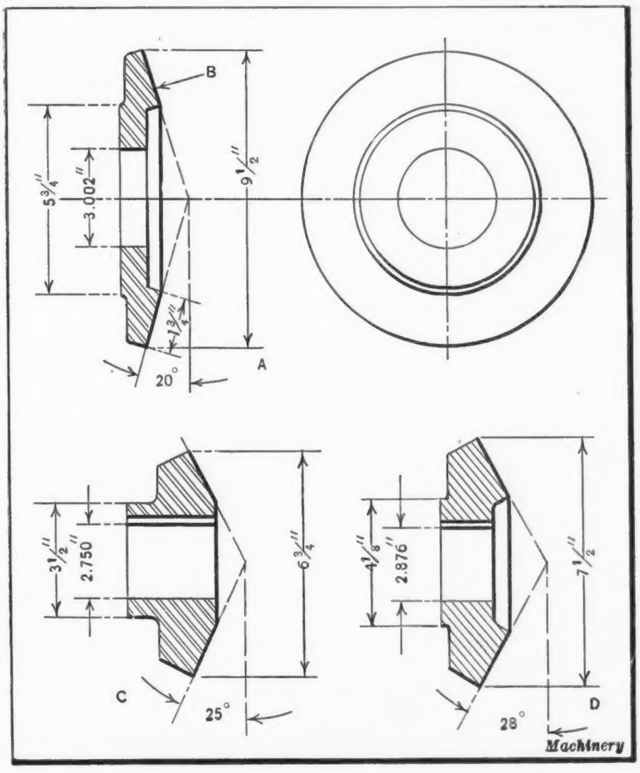


Fig. 1. Bevel Gear Blanks to be machined in the Lathe by the Use of Special Attachments

Many attachments for machine tools are more or less standard in their nature and do not require special comment. Others, such as milling machine attachments for cutting irregular forms or curves, special engine lathe slides for angular work, and multiple milling attachments, come under a head which is close to the automatic field. Let us consider the design of an attachment to be applied to an engine lathe for turning a tapered face *B* on the casting shown at *A*, Fig. 1, the face angle being 20 degrees. Assume that this attachment must also be used for the two other similar pieces shown at *C* and *D*, having face angles of 25 and 28 degrees, respectively. This is an excellent example that illustrates how conditions governing the work may affect the design of the attachment.

It is a comparatively easy matter to design a swivel cross-slide for this job, as shown diagrammatically in Fig. 2, in which the power is derived from the regular feed-screw on the machine and transmitted through bevel gears to a cross-feed screw *E* on the special swiveling slide *F*. The question to be considered before adopting this design is whether this is the best possible way to design an attachment for the purpose required, or whether some other device can be used that will be more flexible in its nature and will give equally good results at a cost no greater or even less than that proposed. Too many designers are hasty in their judgment and do not consider carefully enough the many factors that should govern the design.

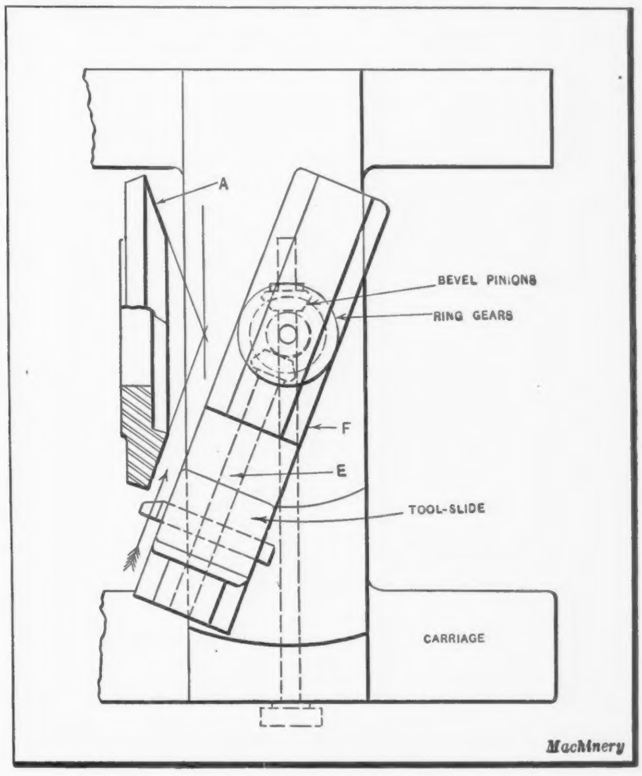


Fig. 2. Special Swiveling Cross-slide for machining the Angular Face of the Gear Blanks

Important Points in Design

Four important points to be considered in deciding on the design of an attachment are as follows:

1. The quantity of work to be machined and the accuracy required. Work produced in small quantities cannot be manufactured economically if it requires an expensive attachment, and therefore economy is an important factor.
2. The general effect of the machining operation on the work.
3. The flexibility of the device, upon which depends the possibility of using it on other work of a similar nature.
4. The effect on the machine to which the attachment is to be applied; that is, the possibility of changes in the machine construction which might injure it for future work.

If the design mentioned is analyzed, it will be evident that after the swiveling cross-slide had been designed and built, considerable work would be necessary to fit it to the machine, and that after this had been done, its utility would be limited, as it would be suited to angular work only. In addition to this the cost of designing and building would be several hundred dollars. Furthermore, no facing or other operations could be done without another setting of the work, all of which would decrease the value of the attachment and involve considerable loss of time in producing

the part. The designer of this attachment might be subjected to criticism in that he had not looked ahead very far but had considered only the operation of machining the angular face. He might say, "We have 5000 pieces to machine to several given angles and so the special swivel cross-slide will be economical." Yet the pieces in question would probably take about four minutes each to machine and

$$5000 \times 4 = \frac{20{,}000}{60} = 334 \text{ hours or only about 7 weeks'}$$

work. After the work was done, the machine would either stand idle waiting for another job of a similar kind, or the slide would need to be removed and the regular carriage replaced, all of which would involve extra expense.

Two More Flexible Designs

A more progressive designer would look further ahead and plan to use a more flexible design like that shown in Fig. 3, in which *A* is the work and *B* the standard cross-slide carriage. In this design, a special sliding tool-block *C* is provided, and a bracket *D* is fastened to the ways of the lathe. The sliding tool-block is so arranged that a regular facing tool can be utilized in a standard tool-holder if desired. On the bracket is mounted a swiveling member *E*, and block *F* which is pivoted to the end of slide *C*, travels in the guide of the swivel *E* when the cross-feed is used. As the carriage moves forward, it carries with it the tool-holder which is made to move along the angular path determined by the setting of the swiveling member.

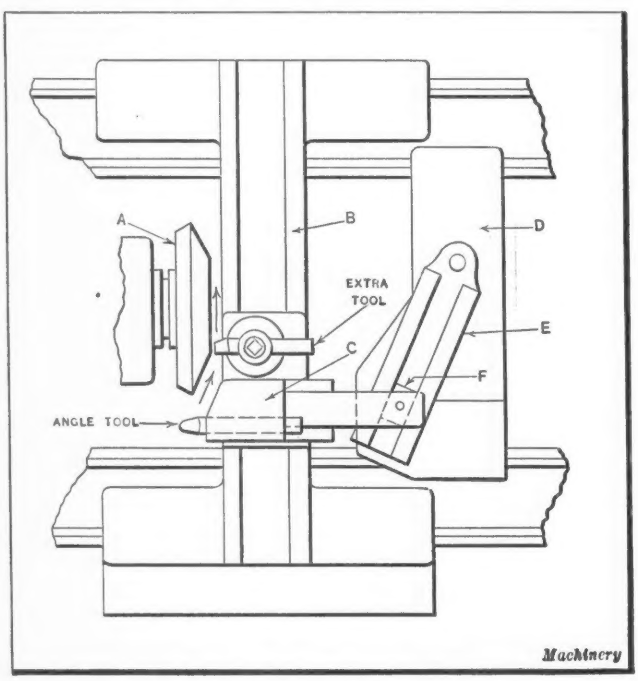


Fig. 3. Angular and Straight Facing Attachment which is limited in Range

From the viewpoint of economy this construction would often be considered satisfactory, yet it might be designed to give a greater range and more flexibility by making it as shown in Fig. 4. The only important difference between this example and that in Fig. 3 is in the construction and mounting of the swiveling member. A bracket *B* is fastened to the ways of the bed and on it is mounted the adjustable holder *C* which carries a circular swivel-block *D* that can be set to any angle desired. In both designs there is provision for straight facing at the same time by using a tool in the regular toolpost. As this is mounted directly on the cross-slide, it does not follow the angular path.

Care must be taken in a design of this kind to give the sliding block a long bearing in order to avoid a cramping action due to its being controlled by the angular guide. The details of construction are dependent upon the type of lathe to which the attachment is applied. A good designer will have no difficulty in making such a device capable of handling a wide range of work. In addition to the economy and range of this attachment, it can be easily applied to and removed from the machine. While this is not strictly an automatic attachment, it operates by itself after the feed has been thrown in.

* * *

MACHINERY EXPORT STATISTICS

Reliable statistics showing United States exports of industrial machinery to the various foreign markets are undoubtedly of considerable help to manufacturers and exporters. A study of the figures often greatly assists in determining the relative importance of the export fields, not only for the machinery particularly mentioned by name, but for related equipment as well.

In an effort further to increase the usefulness of the export statistics, it was arranged that on and after January 1, 1922, all industrial machinery exports would be listed by quantity as well as by value. Furthermore, a large number of new classes and subdivisions were added. Effective January 1, 1924, additional classes have been inserted. These were adopted after requesting and carefully considering the desires of the trade, and it is felt that the present classification represents, on the whole, a vast improvement over the old method of classifying.

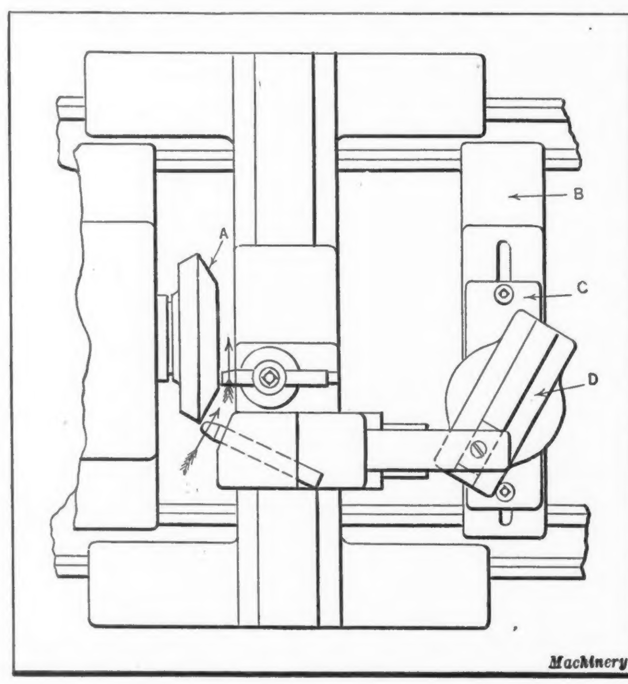


Fig. 4. Similar Design to that shown in Fig. 3 but of Greatly Increased Range

In order to obtain the fullest advantage of these efforts on the Government's part, however, it is necessary that exporters and manufacturers cooperate to the extent of properly executing the shipper's export declaration. The Government merely compiles the figures given to it. It is entirely incumbent upon shippers to see that true facts are furnished on the declaration, this being the only practical way by which export statistics can be obtained. The part played by manufacturers and shippers in the preparation of the export statistics is often overlooked by those using the information compiled.

A fruitful source of errors lies in the practice of shippers leaving the preparation of the export declaration to forwarders or others who have no particular interest in the statistics. The statistics are frequently criticized by manufacturers who do not realize how they are compiled or on what they are based. It is obvious that if the shipper's export declarations are incorrect, the statistics will also be inaccurate. The customhouse officials cannot verify the accuracy of every item.

Letters on Practical Subjects

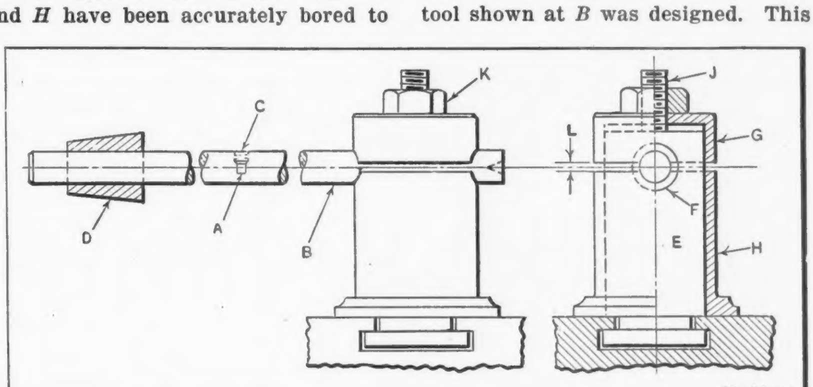
BORING-BAR FOR DEEP HOLES

The ordinary lathe boring tool, of either the forged or inserted-cutter variety, is to a certain extent a makeshift. With such tools extreme care must be taken to insure accurate work, especially when boring deep holes, because the cutting point overhangs or projects beyond the point at which the bar is supported. The amount of overhang depends, of course, upon the depth of the hole being bored. In order to eliminate this overhang, an improved toolpost and boring-bar, such as shown in the accompanying illustration, was designed. The boring-bar of this tool is always supported at two points, the cutting point of the tool bit *A* being located between the two supporting points, so that there is no overhang.

The bar *B* is a piece of cold-rolled steel, its diameter and length being determined by the class of work for which it is to be used. Several slots are provided for holding cutters or tool bits which are made of self-hardening steel. It will be noted, however, that only one slot for holding the tool bit *A* is shown. The cutters are locked in position by means of headless set-screws *C*. When holes are being bored that are considerably larger than the boring-bar, a removable cutter-head may be used to advantage, especially if it is fitted with multiple cutters. The bar is slightly rounded at the headstock end, and the opposite end is accurately centered.

The bushing *D* is made of bronze, and is tapered on the outside to fit the tapered opening in the nose of the live spindle where the loose bushing that ordinarily carries the live center is fitted. Sleeve *D* is bored out to a sliding fit on bar *B*, and is always used to support the boring-bar when taking finishing cuts, so that it will be held concentric with the spindle.

The central portion *E* of the toolpost is made of steel. The dimensions of this part depend to some extent upon the size of the lathe on which it is to be used. The lower end of part *E* is fitted to the toolpost slot in the compound rest, the hole at *F* being located at exactly the same height as the lathe center, but this hole is not finished until the holes in the parts *G* and *H* have been accurately bored to fit the boring-bar. The two pieces *G* and *H* form the outside of the toolpost, and are used to clamp the boring-bar in position. These pieces are made of steel, the part *H* being bored out to a sliding fit on the central member *E*. The upper part *G* is made with a closed top which is bored out to a sliding fit on the threaded end *J* of member *E*. From the preceding description it will be clear that the boring-bar *B* can be securely clamped in the toolpost by tightening the nut *K*.



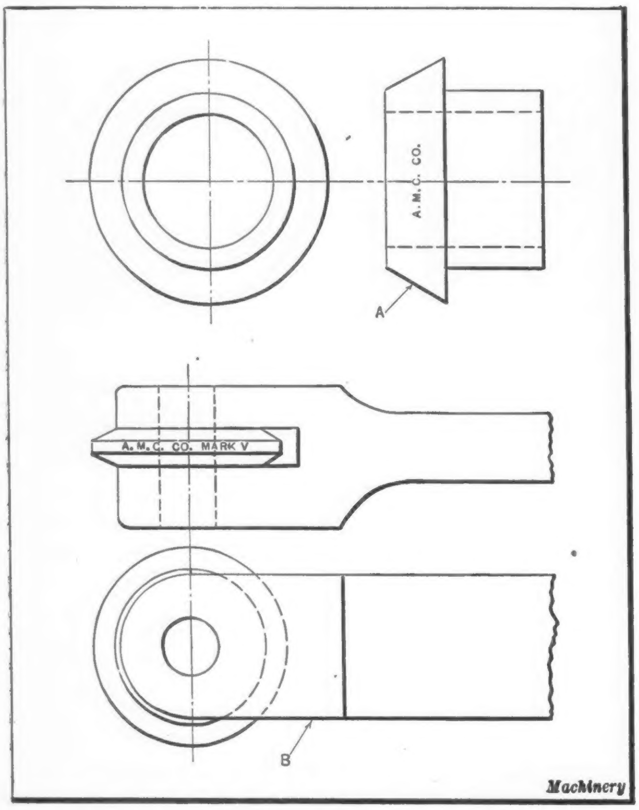
Toolpost for Boring-bar, designed to eliminate Overhang of Point of Cutting Tool

In building the toolpost, part *E* should be made up first, the hole *F* being left unfinished. The two parts *G* and *H* are next made, care being taken to have the height of the lower part equal to the distance from the top of the compound rest to the center of the lathe spindle. The three parts *G*, *H*, and *E* are assembled on the compound rest and locked in place by means of nut *K* when drilling the hole through parts *G* and *H*. The hole is drilled 1/16 inch smaller than the finished size, so that it can be bored out with a boring-bar held in the lathe chuck. After the hole has been finished in this way, parts *G* and *H* are chucked, and 1/16 inch of metal removed from the face of each part so that a clearance *L* is obtained, to provide for locking the boring-bar in place. The hole *F* in the central member is next bored out to provide sufficient clearance for the boring-bar. After they have been machined, the three members of which the toolpost is composed are hardened. The tail-stock center of the lathe is used to center the rear end of the boring-bar, a slight adjustment of the cross-slide usually being necessary to bring the bar into alignment. After this is done, the toolpost is locked in place and the bar is ready for use. The depth of the cut is determined by changing the position of the cutter in the bar. Boring-bars constructed as described provide a means of boring long holes rapidly and accurately.

Spring Valley, Minn. EDWIN KILBURN

ROTARY STEEL STAMP

A certain contract called for the manufacture of several thousand pieces of the form shown at *A* in the accompanying illustration. The material was free-cutting screw stock, and the dimensions had to be held within close limits. Among other requirements was the stamping of each piece upon the conical-shaped end, an operation for which the tool shown at *B* was designed. This tool consists of a tool-steel roller with the required marking embossed on the periphery as shown in the illustration. The roller is mounted in the holder so that it is free to rotate on the center pin. The lettering projects beyond the adjacent surface an amount equal to the required depth of the marking.



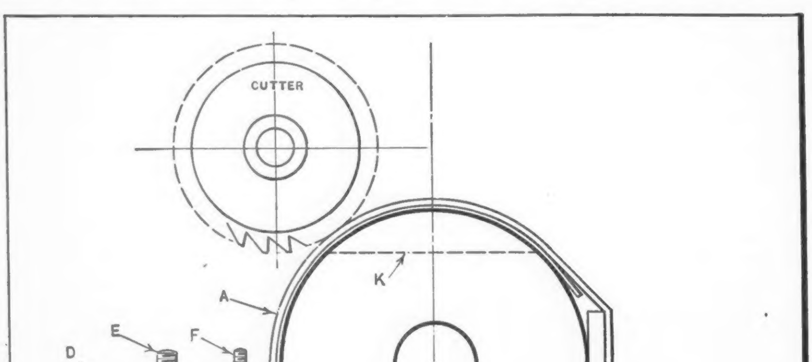
Rotary Tool used for marking Letters on Conical Steel Part

In operation, the pieces *A* are gripped on the cylindrical part by a universal chuck and slowly rotated, while the tool *B* is held in a toolpost and fed against the conical surface with sufficient pressure to cause the roller to rotate. It is necessary, of course, that the blank or unlettered part of the stamping roll be brought into contact with the work in such a manner that the marking will be reproduced at one place. One revolution of the piece thus completes the stamping. Theoretically, there is a certain amount of slippage between the cylindrical surface of the roller and the conical surface of the piece. With this narrow stamp, however, the slippage is so slight that it has no effect on the appearance of the work.

St. Louis, Mo. P. H. WHITE

HOLDING LARGE CYLINDRICAL WORK

The method shown in the accompanying illustration for holding the cylindrical piece of work *W* was devised primarily for use when taking milling cuts at right angles to the center line of the work, as indicated by the dotted line at *K*. One of the difficulties often experienced in performing milling operations of this kind is that the milling cutter has a tendency to cause the work to revolve. With the work held in place as shown, this trouble is entirely eliminated.



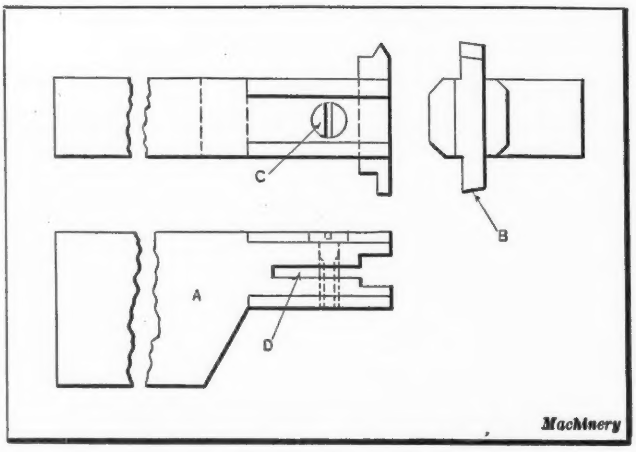
Method of holding Cylindrical Work while milling

In setting up the holding device, angle-iron *H* is first lined up on the machine table and bolted down. The work is then brought up to the face of the angle-iron by a piece of scrap steel *A*, about 1/16 inch thick by 2 1/2 inches wide, which is bent to the form shown. The strap formed by this piece of scrap steel has a hole drilled in each end to permit it to be fastened to the angle-iron by stud *G* and to the strap *D* by bolt *F*. It will be noted that the clamping strap *D* rests on the heel block *C* and that the work will be clamped securely in place when the nut on bolt *E* is tightened. It is preferable to place a strip of cardboard *B* between the work and strap *A* in order to increase the friction holding power of the latter member.

Fitchburg, Mass. E. E. LAKSO

BORING, RECESSING AND THREADING TOOL

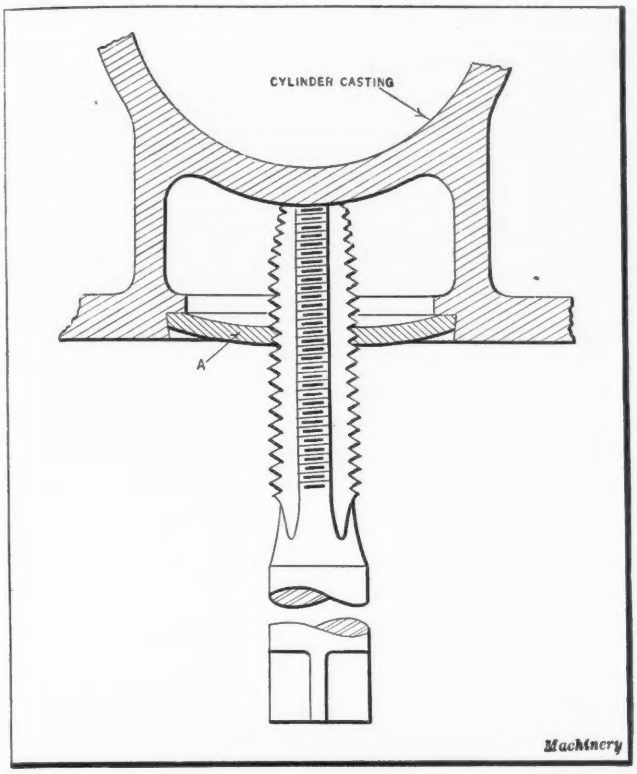
The tool shown in the accompanying illustration was used to good advantage in cutting internal threads in a lot of 2000 bronze castings. The tool-holder *A* is made from a piece of cold-rolled steel, 5/8 inch thick, 1 1/2 inches wide, and 5 inches long. The corners on the front end are turned off, and a 1/4-inch slot is milled across the end of the holder, in which the tool bit *B* is a tight fit. A 1/16-inch slot *D* is sawed 1 inch deep in the center of the 1/4-inch slot. A hole is drilled, tapped, and counterbored for the fillister-head screw *C* which is employed to clamp the bit in place. The tool bit is ground on one end for cutting a recess 1/8 inch wide, and on the other end for cutting a 32-pitch V-thread, as indicated in the illustration.



Combination Boring, Recessing, and Threading Tool

In using this tool, the casting is first rough-counterbored; then the lathe is reversed and the recessing tool used as a boring tool to size and true up the hole. On reaching the bottom of the blind hole the recess is cut to the required depth. The tool is next withdrawn and set over to the proper position for cutting the thread. For the latter operation, the lathe spindle must, of course, be reversed so that it runs in the usual direction. Only two cuts are required to finish the threads to size. In doing this work, the lathe was operated at fast speed which resulted in rapid production and, at the same time, accurate work.

Fitchburg, Mass. A. BERG



Using a Tap to extract a Core Plate from an Automobile Engine Cylinder

EXTRACTING CORE PLATES WITH A TAP

In overhauling an automobile engine, it became necessary to remove the core plates *A* in the side of cylinder jackets in order to dislodge the scale and sediment. These core plates are driven into the casting and depend only on a force fit to make them tight. The method employed for removing them was as follows: A hole was first drilled through the center of the plate. Then, after cutting the thread in the plate in the usual way, the tap was screwed in until it came in contact with the cylinder wall; further rotation of the tap resulted in forcing the plate out. Instead of providing new plates when the engine was reassembled, the old ones were used, taper plugs being screwed into the plates to expand them sufficiently to produce a water-tight joint.

Washington, D. C. G. A. LUERS

SIMPLIFYING CUT-AND-TRY METHODS BY GRAPHICAL PLOTTING

The writer recently saved considerable time in solving a spiral gear problem by graphically plotting the results obtained by cut-and-try computations. The problem was to find the helix angles of a pair of spiral gears, when the center distance, diametral pitch, and number of teeth were given. A helix angle was first assumed, and the corresponding center distance then calculated. Naturally the center distance obtained by the first trial showed that the assumed angle was not correct. The result, however, suggested another helix angle which gave a center distance more nearly correct, but which was still not exactly right.

The assumed helix angles were next plotted as ordinates and the corresponding center distances as abscissas. From this chart it was an easy matter to select an angle which gave almost exactly the required center distance. Without the aid of this simple graphical means of determining the correct angle, it is probable that several calculations would have been required. Considerable time may be saved in solving many of the problems met with in the drafting-room by employing similar graphical methods.

Cambridge, Mass. RAYMOND B. TEMPLE

PORTABLE PNEUMATIC BOLT-CUTTER

The portable pneumatic bolt-cutter shown in Fig. 2, has a frame *A* constructed of 1- by 10-inch channel iron and iron plates 1 inch thick by 12 inches wide by 61½ inches long. The cutting lever *B* is actuated by a 14- by 12-inch air-brake cylinder *C* such as is used for the wheel brakes of a locomotive. The distance from the fulcrum pin *D* to

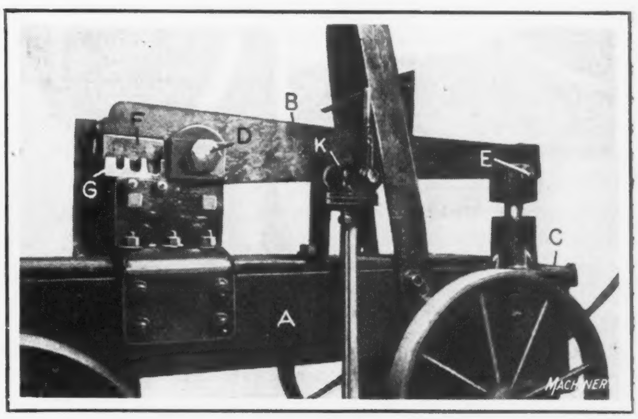


Fig. 2. Air-operated Bolt-cutter

the pin *E* is about 50 inches, and the distance from pin *D* to the outer end of the cutter *F* is about 11 inches. The air supply to the cylinder *C* is controlled by the Westinghouse air-brake valve shown at *K*. Either of the two sets of cutters *F* and *G* or *H* and *J*, Fig. 1, can be used on the bolt-cutter.

The cutters shown at *F* and *G* are used for cutting off bolt stock that is to be threaded, as they cut the material off straight and smooth. The cutters *H* and *J* are intended for use in cutting scrap bolts of any size from ⅜ inch up to 1⅝ inches in diameter. The latter cutters are so designed that the stock can be readily cut off without taking any particular care in locating it between the cutting edges. As the bolt-cutter is mounted on wheels, it can be easily moved around the shop and put in operation wherever connection can be made with the air pressure system.

Chattanooga, Tenn. H. H. HENSON

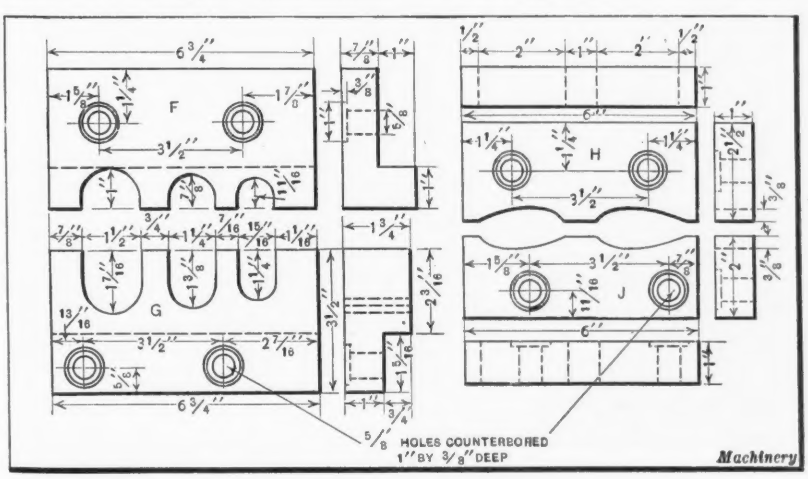


Fig. 1. Cutters used on Machine shown in Fig. 2

HEAT-TREATING SMALL STEEL SPRINGS

Many mechanics find it difficult to temper small or delicate springs satisfactorily. Of course it is not difficult to harden the steel, but to draw the temper evenly on a piece of steel 0.025 inch thick, for instance, requires

some experience, especially if the spring is of considerable length in proportion to its width and thickness or is of a crooked or formed shape. However, the writer has found that the simple method described in the following will produce good results.

A small cup that has no soft soldered joints is filled about two-thirds full of sperm oil. The spring is laid on a piece of charcoal, heated evenly with a blowpipe, and dropped into the oil in the cup. The cup is then placed over a flame and heated until the oil flashes and takes fire. The oil is kept burning for about six minutes, after which the cup is removed from the flame, covered over with a piece of metal, and allowed to cool. An even or uniform temper will be obtained if the method described has been carefully followed.

Rochester, N. Y. JAMES H. BEEBEE

LATHE ATTACHMENT FOR CUTTING ELLIPTICAL GROOVES

The manner in which an old discarded lathe was equipped for cutting elliptical grooves in metal washers is shown in Fig. 1. One of the washers in which the groove has been cut is shown mounted on the faceplate at *A*. In equipping the lathe for this work, it was necessary to disengage the cross-slide feed-screw so that the tool-block *B* would be free to slide in or out. The special toolpost plate *C* carries a roller mounted on pin *D* at a certain distance from the tool-post. This distance is determined by the relative positions of the work and the groove in the master plate *E* which is attached to the lathe faceplate.

The elliptical groove in the master plate is made to conform to the shape of the groove to be cut in the washer. At the center of the master plate *E*, Fig. 2, is a fixed stud *F*. The work is driven by a pin or stud *G*, which can be adjusted in the radial slot in the master plate. The washers are faced on both sides, bored, turned, and drilled before being grooved. The holes are drilled on a circle scribed midway between the outer rim and the bore. In any washer, the width of the rim is not less than the difference between the minimum and maximum radii of the elliptical groove cut in the master plate.

The driving stud *G* can be adjusted radially, as previously mentioned, to suit the holes drilled in the work. The retaining disk or holding plate *H* is a good fit on stud *F*, and has a lip or shoulder at its outer edge which centers the work on the faceplate. In operation, the tool is advanced by moving the carriage forward by hand. The cross movement of the grooving tool *J*, Fig. 1, is controlled by the groove in the master plate in such a way as to produce an accurate ellipse which passes through the four holes drilled through the washer. The master plates *K* and *L*, Fig. 2, are used in the same way as the one shown at *E*.

Evansville, Ind. O. L. KAMPSCHAEFER

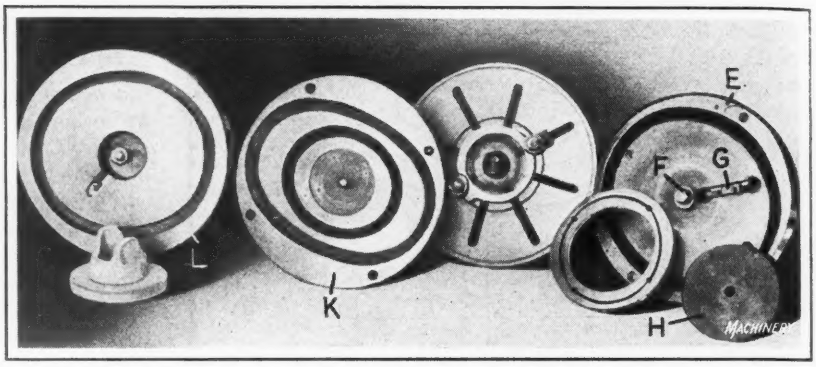


Fig. 2. Master Plates used with the Lathe Equipment shown in Fig. 1

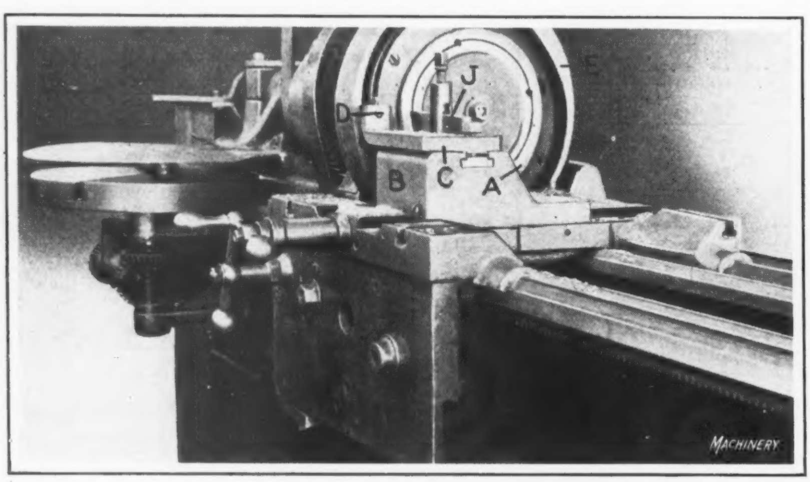
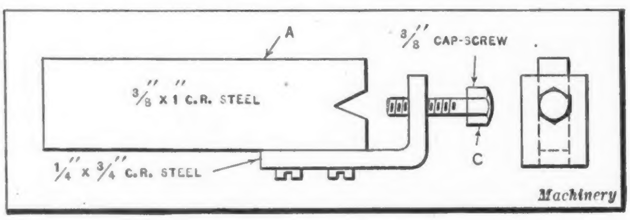


Fig. 1. Lathe equipped for cutting Elliptical Grooves in Washers

CENTERING GAS ENGINE VALVES

The device shown in the accompanying illustration has proved very useful in centering the head and shank ends of gas engine valves. The valves for which the device was originally designed have steel stems with cast-iron heads. The stems are finished to a diameter of 5/16 inch, and as only 0.010 inch is removed from the stems in the finishing operation, it is necessary that the work be accurately centered. The usual procedure was to pass the head of the valve back through the jaws of a scroll chuck mounted on the lathe spindle and tighten the jaws on the valve stem. A center drill held in the tailstock was then employed to produce the center.



V-block used in centering Valve Stems

This method of chucking the work necessitated opening the jaws of the chuck rather wide in order to permit the head of the valve to pass through, and considerable time was required in opening and closing the jaws. In using the device shown in the illustration, the shank of the V-block *A* is held in the lathe toolpost with the vee carefully lined up with the center of the spindle. This is done by adjusting the vee in block *A* against a true running piece the size of the valve stems. Either end of the valve to be centered is gripped in the chuck and the free end of the valve carried in the V-block, the cap-screw *C* being adjusted to hold the stem in the V-shaped groove in block *A*.

Algona, Iowa GEORGE WILSON

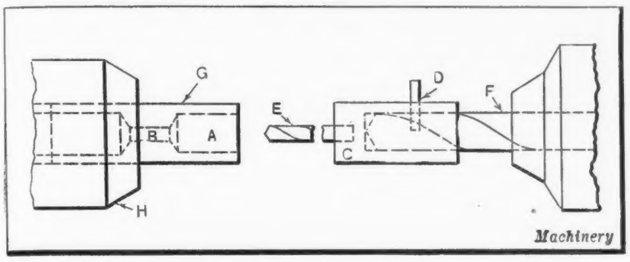
* * *

There is somewhere to be found a plan that will preserve the character of man and yet will enable us to socially and economically synchronize this gigantic industrial machine built out of applied sciences. There is no one who could make a better contribution to this than the engineer, but to make that contribution our engineers have got to have a broader and stronger place in world affairs than they have today. The engineer must start with a sense of his public obligations as well as his professional knowledge.—*Herbert Hoover*

Shop and Drafting-room Kinks

DRILL ADAPTER FOR BENCH LATHE WORK

The drill adapter here illustrated has proved a great time-saver in producing parts like the one shown at *G*. The small drill *E* is soldered to the piece of round stock or adapter *C* which has a blind hole in one end, the same size



Adapter used to hold Small Drill at End of a Large Drill

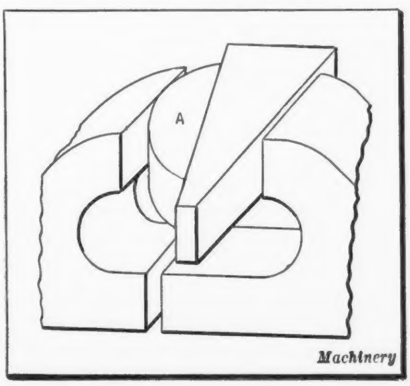
as the drill *F* employed in drilling the large hole at *A* in the work *G*. The stop-pin *D* which prevents the drill from turning in the adapter may be located at any convenient point.

When the device is in use, the work is gripped in a draw-in collet *H*, and the drill *F* fed into the work to the required distance. After drill *F* has been withdrawn, the adapter is slipped over its cutting end. The stop-pin *D* follows the twist of the drill *F* until its point reaches the bottom of the hole in the adapter, as shown in the illustration. The small drill centers itself in the center left by the large drill and can be fed into the work in the usual manner when drilling hole *B*.

Fitchburg, Mass. ALBERT BERG

BLOCK FOR HOLDING TAPERED WORK IN THE VISE

Holding irregular or wedge-shaped parts in the vise while chipping, sawing, or performing other manual operations is awkward unless the parts are supported by blocking. It is possible, however, to hold tapered work quite securely by using a simple block such as shown at *A* in the accompanying illustration, in conjunction with the regular vise jaws. This special block should be about the same width as the jaws, the convex side being made semicircular. It is preferable that the flat side of the block be checked or grooved in order to give it a better grip on the work.



Method of holding Tapered Work in the Vise

Washington, D. C. GEORGE A. LUERS

PLATING SMALL PARTS FOR IDENTIFICATION

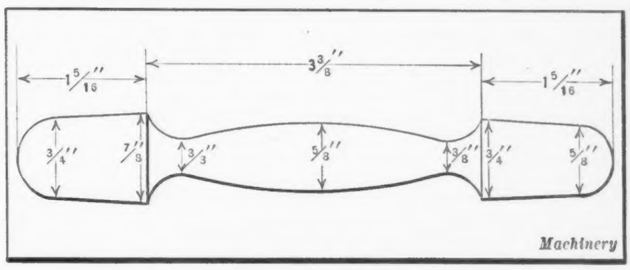
In shops where large numbers of small parts are used, there are often a good many pieces that closely resemble one another and that cannot be distinguished except by gaging. It frequently happens in such cases that stocks become mixed, or that the wrong part is used by the assemblers, with consequent delays and losses.

Where appearance is not an essential consideration, this trouble can be prevented by giving a blue oxide finish to steel or brass parts or by lightly plating them. For plating, the three colors available are nickel, brass, and copper, giving a distinctive finish to any pieces on which they are used. This treatment is very inexpensive and but little skill is necessary to obtain the quality of finish required. Oxidizing or plating is also well adapted to marking left-handed, special, or metric-threaded screws and nuts and other special parts that might be mistaken for a regular or standard product, so that they can easily be sorted should they become mixed.

Bridgeport, Conn. D. W. MCCROSKY

FILLET-SMOOTHING TOOL

A tool that patternmakers will find very useful for smoothing putty or wax fillets on patterns is shown in the accompanying illustration. This tool is turned from brass



Tool for smoothing Putty and Wax Fillets

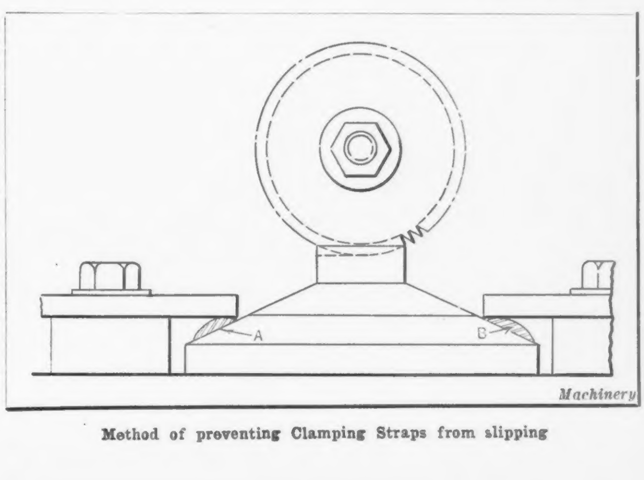
rod and smoothed up nicely. In use, a roll of putty in a more or less stringy form is laid in the corner to be filled and the tool pressed down on the putty and drawn over it until it is smoothed down. Beeswax is applied in the same way, except that the tool is warmed slightly so that it will melt the beeswax.

Denver, Col. R. M. THOMAS

PREVENTING CLAMP-STRAPS SLIPPING

The slipping of the ends of clamping straps on the inclined surfaces of work such as shown in the accompanying illustration may be prevented by placing pieces of old half-round files *A* and *B* under the ends of the straps. The flat side of the file should be in contact with the work so that the clamping strap will bear on the rounded side of the file.

Ypsilanti, Mich. FLOYD GRAVES



Method of preventing Clamping Straps from slipping

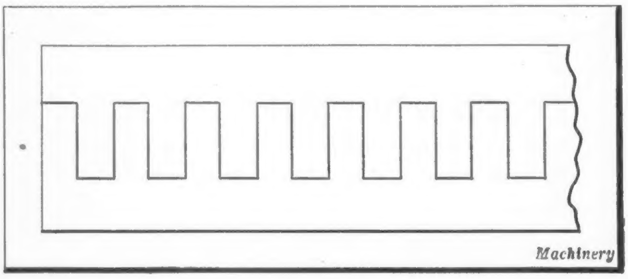
Questions and Answers

PROBLEMS IN SHEET-METAL WORK

W. C. A.—In the manufacture of metal corner beads, narrow strips of stock in lengths of from 6 to 12 feet are first perforated and then rolled. We understand that in this work rotary perforating dies have been used, and would appreciate information from MACHINERY'S readers on this subject.

When long pieces of metal are formed in a die in the power press, 6 inches or more are sometimes formed up at one stroke. Information relating to how this work is done on long strips in a power press instead of in a large brake press would be of interest.

At the present time we are planning to split a strip of 26-gage galvanized steel, as shown in the accompanying illustration, in about the same way that piano hinges are split before the curling operation. Piano hinges are usually in the neighborhood of 5 feet long, and we understand that they are not sheared in one stroke of a five-foot die. These hinges are usually made of brass or zinc, and the object of splitting is to eliminate the waste of stock that would result if a strip of the proper width were notched. Complete information covering the method of doing this work would be appreciated.



Strip of Galvanized Steel to be split as shown

CALCULATING DISTANCE BETWEEN SHAFT CENTERS

F. I. M.—An occasion has arisen where it is desired to be able to calculate the distance between two shaft centers when the length of an endless belt and the diameters of the pulleys are known. Can you give me a formula for determining this distance?

ANSWERED BY W. F. SCHAPHORST, NEWARK, N. J.

The following formula will give the distance between shaft centers required directly:

$$C = \frac{\sqrt{L^2 - 6.28L\,(R+r) + 9.87\,(R+r)^2 - 4\,(R-r)^2}}{2}$$

where C = distance between shaft centers, in inches;
L = length of belt, in inches;
R = radius of large pulley, in inches; and
r = radius of small pulley, in inches.

This formula will take care of cases where there is considerable difference in the radii or even where pulleys have the same radius.

For example, take an instance where $L = 100$ inches, $R = 10$ inches, and $r = 4$ inches.

Substituting these values in the formula, we get:

$$C = \frac{\sqrt{10{,}000 - 8792 + 1933 - 144}}{2} = \frac{\sqrt{2997}}{2} = 27.4 \text{ inches}$$

A simpler formula for use where pulleys have the same radius or where they are very nearly the same is as follows:

$$C = \frac{L - \pi\,(R+r)}{2}$$

To prove that this formula does not give the same results as the first one, let us take the same problem, namely, $L = 100$ inches, $R = 10$ inches, and $r = 4$ inches.

Substituting in the second formula we get:

$$C = \frac{100 - 3.14\,(10+4)}{2} = 28 \text{ inches}$$

In other words this "approximate" formula will give us a "tight" belt.

HOW CAN BLUEPRINTS BE MADE TO ADHERE TO CELLULOID?

H. J. H.—If any reader of MACHINERY has been successful in developing a method for making blueprints adhere to celluloid, a detailed description of this method would be appreciated. The writer has tried glue, but when it dries it does not adhere to the celluloid. Shellac, when dry, cracks and also makes the celluloid curl.

ANSWERED BY CHARLES A. LOYDA, MILWAUKEE, WIS.

In answer to this question, the writer would suggest the use of collodion, which may be purchased at any drug store. If the blueprint is small, this method will be satisfactory, but if the prints are large, it may prove too expensive. The collodion must be applied quickly, as it dries rapidly, and if a large surface is to be covered, it must be spread on with a brush. Ether is the solvent employed in preparing collodion and must be used in cleaning the brush—an operation which is rather expensive.

If the blueprint is a small one, the collodion can be applied with a metal or glass rod spreader. The print and the celluloid are placed together very quickly, and held together for a few minutes under a slight pressure such as is obtained by using a book for a weight. It should be borne in mind that collodion is inflammable and explosive, being somewhat similar to guncotton or nitroglycerin. A little experimenting may be required to obtain the desired results. As the collodion is transparent, the blueprints may be mounted either face up or face down on the celluloid.

ANSWERED BY ANDREW W. WILKS, BREWSTER, N. Y.

After reading H. J. H.'s question in March MACHINERY, "How Can Blueprints be Made to Adhere to Celluloid?" the writer did a little experimenting with some homemade "dope" which consists of some scrap motion picture film, banana oil, and wood or denatured alcohol. This mixture has been used by the writer instead of shellac on coils for radio use. The motion picture film is first washed in hot water to dissolve the emulsion and then dissolved in banana oil. As much film is used as can be cut or dissolved by the oil. This gives a very thick mixture to which the alcohol is added. At present the writer has a mixture of this kind which is about as thick as glycerin and which he has found by experiment to be satisfactory for attaching paper to celluloid. The mixture should be applied to the paper instead of to the celluloid, as it dries very quickly and will not stick to the paper if applied to the celluloid.

It might be mentioned here that celluloid glue used in piano repair shops for attaching the celluloid tops to the wooden keys, is made from scrap pieces of celluloid dissolved in denatured alcohol. The wood and the celluloid must, of course, be held together under pressure until the celluloid glue sets. Most motion picture operators use a mixture of scrap film and ether for joining the broken ends of film, as this mixture provides a very quick drying and setting cement.

ANSWERED BY VICTOR ARKIN, CHICAGO, ILL.

It is a simple matter to make a blueprint adhere to celluloid if the proper grade of celluloid, suitable adhesive liquid, and a uniting machine are employed. The celluloid and the adhesive liquid used by the writer are obtained from the Eastman Chemical Corporation, of Rochester, N. Y. The uniting machine is a simple affair, consisting of a cast-iron plate, about 20 by 40 inches in size, with a guard rail on each side and a cast-iron roller weighing about 200 pounds, which rolls freely on the plate inside the rails. The roller has a shaft through its center, and a long handle is attached to the shaft to facilitate handling. At one end of the table or plate is an opening under which a gas burner is placed. A piece of flannel is stretched over the plate.

The method of applying the blueprint to the celluloid is as follows: The roller, when at rest, is located over the gas flame and should be kept just hot enough to cause water to boil when dropped upon its upper surface. However, the gas burner should be so located that the flame does not actually touch the roller. Care must also be taken to keep the celluloid away from the flame, and for this reason the burner should be boxed in with sheet metal. The sheet of celluloid is first laid on the flannel which is stretched over the plate. Next, the blueprint is dipped in a bath of the adhesive liquid and placed on the celluloid. A blotter is then laid over the blueprint and the heavy roller drawn slowly back and forth over the blotter until the blueprint has been thoroughly dried. In the course of time the celluloid print may have a tendency to curl, but this may be avoided by pasting it on a piece of heavy cardboard.

TOOL DIVISION SYSTEM

L. H. T.—I am engaged in organizing a complete system for a tool division—a system that covers both the design and making of tools and their maintenance and repair. I am especially interested in systems used in shops engaged in quantity production and employing from 1000 to 2000 men. If someone who is familiar with such a system would outline it in detail, it would prove of great assistance to me.

ANSWERED BY JOHN J. BORKENHAGEN, CICERO, ILL.

To describe in detail a tool division system such as desired would require considerable space. I would suggest, therefore, that MACHINERY'S Book, "Shop Management and Systems," by Franklin D. Jones and Edward K. Hammond be referred to. On several occasions I have referred to this book, and the information obtained has helped me to improve the systems already in use. I believe that L. H. T. will find the solution to his problems on tool division systems in this book, and would suggest that he turn to page 192.

NORMALIZING

F. M. D.—What is meant by the normalizing of steel? In what way does it differ from ordinary annealing, and under what conditions is steel normalized rather than annealed?

ANSWERED BY STANLEY P. ROCKWELL AND R. W. WOODWARD, HARTFORD, CONN.

Normalizing of steel is a special case of annealing and may be defined as heating the steel above the critical temperature and cooling it freely in air. Annealing consists in heating at any elevated temperature and cooling at a relatively slow rate. It may be necessary, in the case of annealing, to hold the temperature for many hours or even days, whereas in normalizing it is sufficient to secure an even penetration of the heat throughout the material. The purpose of annealing is (a) to soften steel for machining, cutting, stamping, etc., or for some particular service; (b) to refine the grain and reduce brittleness; and (c) to relieve stresses and hardness resulting from cold work.

Normalizing is intended to put the steel into a uniform, unstressed condition of proper grain size and refinement so that it will properly respond to further heat-treatments. It is particularly important in the case of forgings which are to be later heat-treated. Normalizing may or may not (depending upon the composition) leave steel in a sufficiently soft state for machining. In some cases annealing for machineability is preceded by normalizing, and the final result is much better than a simple anneal.

The annealing temperatures are usually above the critical range, although not in general as high as those used in normalizing. Temperatures below the critical range are used in softening for machining and in removing the effects of cold-working. In general, the lower the temperature, the longer the time must be to bring about a desired softening.

PRECEDENCE IN THE EXAMINATION OF PATENT APPLICATIONS

H. W. C.—Is it possible to have an application for a patent taken up for examination out of its regular order? I have an invention for which I have made an application for letters-patent, and have what I consider an advantageous offer for an interest therein when the patent is issued; I am therefore eager to expedite matters in every way possible.

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

Original applications for letters-patent are taken up for examination in the order of their filing, and no application will be given precedence over that of another, except in certain special instances. If the invention is deemed of particular importance to some branch of the public service, and if for that reason the head of a government department requests immediate action, and the Commissioner of Patents so orders, the case will be taken up out of its turn.

Applications may also be advanced for examination by the Commissioner to expedite the business of the office, or upon a duly verified showing by the applicant that a delay will probably cause irreparable loss or injury. Orders to expedite the examination of applications on these latter grounds are rarely issued, and in your case it would be necessary to show beyond a reasonable doubt that the party intending to purchase an interest in your invention when the patent is issued will not do so unless you receive favorable action from the Patent Office within a time that would be beyond that of ordinary routine procedure.

WEIGHT PER DRIVING AXLE OF LOCOMOTIVES

A. C.—What is the average weight per driving axle of locomotives in present-day designs?

A.—Based on the authority of a paper read by James Partington, estimating engineer of the American Locomotive Co., Schenectady, N. Y., before the New England Railroad Club, the weight per driving axle of present-day locomotives varies from about 55,000 pounds to 70,000 pounds. During the period of government control, when standard locomotives were designed, these locomotives were built with a height and width that would permit their operation generally throughout the country, being designed for the capacity of the road bed and bridges, and the clearance limits of the right of way of all the main-line roads. The weight per driving axle of these locomotives was taken as 55,000 pounds for the light designs, and 60,000 pounds for the heavy designs. These dimensions and weights conform to the average limiting physical conditions of the railroads in the United States in 1917, and these conditions remain practically the same today. The roads that have more liberal clearances and can operate locomotives with greater axle loads are doing so, and have put heavier and more powerful locomotives in service; hence, engines with axle loads of 65,000 pounds are becoming more numerous, and in a few cases steam locomotives with axle loads as high as 70,000 pounds are in service. Electric locomotives are now being built with an axle load of 75,000 pounds. This will very likely be the maximum limit until further improvements can be made in the carrying capacity of rails.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, April 14

A SURVEY of all the principal engineering industries shows that although output as a whole is still very much below normal capacity, a steady improvement is taking place. Wage disputes continue to have a depressing influence, and if this factor could be relieved there is no doubt that the general improvement would be more noticeable, as it is reported from many industries that this uncertainty causes a reluctance to place contracts, especially at a time when industry is convalescent and feeling its way. It is anticipated that production costs will increase in the next few months, and the present hesitancy on the part of would-be purchasers appears, therefore, to be influenced more by the general industrial difficulties, in which labor is the most prominent factor, than by questions of price.

The Machine Tool Industry

In many important sections, machine tool makers are sharing in the general growth of engineering business, but in a few districts, notably Manchester, the machine tool industry has not yet responded with any certainty. Few machine tool works in this area are working at more than 50 per cent capacity, and competition for possible orders is ruthless; a few individual manufacturers report that they found March an improvement over February. In this center, German machine tools, usually of standard types, are being offered at low prices, but are not attracting much attention. On the other hand, German buyers are again coming into the machine tool market, and in Yorkshire several German inquiries for the heavier classes of machine tools have been received. In this locality, makers of power presses and hydraulic tools are well occupied.

In the Midlands, several machine tool works are engaged at full capacity, and there has been a cumulative all-around improvement since the beginning of the year. The principal customers are railways and industries directly affected by railway contracts, as well as the automobile and electrical industries. India, Australia, and Japan are the most prominent overseas purchasers, and the export trade of machine tools generally appears to be developing satisfactorily.

The last few months have seen a weeding out of the less stable concerns in the engineering industry, and the number of machine tools on the second-hand market has appreciably increased as the result of these firms going into liquidation. Many such tools can reasonably be supposed to be more saleable than the remnant of war-time machines still in dealers' hands, and the fact that these machines have had little apparent effect in prejudicing the general improvement in the machine tool market suggests that the present activity is well founded.

Small tool makers generally continue to be busy, and in milling cutters, jigs, fixtures, and gages a very steady demand is being experienced. The business in twist drills is showing a notable increase, and Germany, who before the war was a large buyer from several Sheffield firms, is again inviting quotations for twist drills.

Exports and Imports of Machine Tools

The exports of machine tools rose from £92,500 in January to £101,000 in February, the tonnage rising from 852 to 941. These are the first increases recorded since last November, which was the export peak month for 1923, with a value of about £160,000. Imports rose from £36,800 in January to £38,600 in February, the corresponding tonnages being 204 and 229. The value per ton of imports remained high, as compared with last year's figures, being £170 to £180. The value per ton of exports in February was £107.

Lathes were most prominent among exports during February, and had a total value of about £43,000; drilling machines exported amounted to £14,700. Apart from the total of the classes of machines unclassified in the official returns, grinding machines were the most prominent among imports, representing a total value of £7400, with the very high value per ton of £276.

The General Engineering Field

Engineering generally shows a more regular improvement than is to be seen in the special branch of machine tools. The very large section of the engineering industry devoted to textile mill equipment is now receiving many more inquiries, despite the fact that there is no improvement in the cotton trade. Very few of the Lancashire textile mills have installed new machinery during the last ten years, and new equipment is imperative, especially as the textile machine builders are among the most progressive sections of the engineering industry and can offer equipment that will effect considerable economies in working.

In the electrical industries, conditions continue to be highly satisfactory. Manufacturers have been enabled to return to the pre-war relations between productive costs and selling price, and have maintained a better measure of employment since the war than any other branch of the engineering industry. Only one important part of the electrical industry fails to show an improvement, and that is the section making motors for factory driving purposes.

Rolling stock makers have enough work in hand, both for home and foreign railways, to keep them occupied for several months. Private locomotive building firms, although not working up to capacity, have orders going through for Indian railways, and the tendency of home railways to keep the capacity of their shops fully up to their own locomotive requirements is causing private firms to look abroad for the bulk of their work; such foreign orders are being obtained in the face of keen competition from other countries.

Manufacturers of the higher grades of chain, such as roller chains and inverted-tooth types, are experiencing a heavy demand, but makers of the cruder types of chain which have many uses industrially, complain of a scarcity of work.

In spite of the greatly increased capacity of the automobile industry, the demand is far from being satisfied, and thousands of purchasers cannot obtain early delivery. The automobile industry is well ahead of other branches of engineering in the rate of development and most factories are running at high pressure. In the Coventry district, the largest automobile manufacturing center, there is practically no unemployment.

British automobile manufacturers have recaptured much of the lost ground in the home market for the lower priced cars, foreign makers having experienced a decided check in this market. At the same time there is a considerable expansion in overseas business, and the exports so far this year are double those of the corresponding period last year. Motorcycle and bicycle makers are sharing in this expansion of business, and engine manufacturers cannot keep pace with the demand for engines to fit assembled cycle frames.

TOLERANCES FOR GROUND THREAD TAPS

Tolerances Proposed by the National Screw Thread Commission (Stock Taps are made Slightly Larger to Meet the Present Demand).

UNITED STATES STANDARD

Size	Basic		Tap Measurements					
			Outside Diameter			Pitch Diameter		
	Outside Diam.	Pitch Diam.	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
1/4-20	0.2500	0.2175	0.2520	0.2535	0.0015	0.2175	0.2183	0.0008
5/16-18	0.3125	0.2764	0.3145	0.3160	0.0015	0.2764	0.2772	0.0008
3/8-16	0.3750	0.3344	0.3770	0.3785	0.0015	0.3344	0.3352	0.0008
7/16-14	0.4375	0.3911	0.4400	0.4415	0.0015	0.3911	0.3920	0.0009
1/2-13	0.5000	0.4500	0.5025	0.5040	0.0015	0.4500	0.4509	0.0009
9/16-12	0.5625	0.5084	0.5650	0.5665	0.0015	0.5084	0.5094	0.0010
5/8-11	0.6250	0.5660	0.6275	0.6290	0.0015	0.5660	0.5670	0.0010
3/4-10	0.7500	0.6850	0.7530	0.7550	0.0020	0.6850	0.6861	0.0011
7/8- 9	0.8750	0.8028	0.8780	0.8800	0.0020	0.8028	0.8040	0.0012
1 - 8	1.0000	0.9188	1.0030	1.0050	0.0020	0.9188	0.9201	0.0013
1 1/8- 7	1.1250	1.0322	1.1290	1.1310	0.0020	1.0322	1.0336	0.0014
1 1/4- 7	1.2500	1.1572	1.2540	1.2560	0.0020	1.1572	1.1586	0.0014
1 3/8- 6	1.3750	1.2668	1.3790	1.3810	0.0020	1.2668	1.2682	0.0014
1 1/2- 6	1.5000	1.3917	1.5040	1.5060	0.0020	1.3917	1.3932	0.0015
1 3/4- 5	1.7500	1.6201	1.7550	1.7570	0.0020	1.6201	1.6216	0.0015
2 -4 1/2	2.0000	1.8557	2.0050	2.0070	0.0020	1.8557	1.8572	0.0015
2 1/4-4 1/2	2.2500	2.1057	2.2560	2.2580	0.0020	2.1057	2.1072	0.0015
2 1/2-4	2.5000	2.3376	2.5060	2.5080	0.0020	2.3376	2.3391	0.0015
2 3/4-4	2.7500	2.5876	2.7570	2.7590	0.0020	2.5876	2.5891	0.0015
3 -3 1/2	3.0000	2.8144	3.0070	3.0090	0.0020	2.8144	2.8159	0.0015

LEAD TOLERANCE

A maximum lead error of plus or minus 0.0005 inch in one inch of thread is permitted.

MARKING

Taps will be marked with the diameter, number of threads per inch, and standard. A symbol indicating ground thread is also recommended, for example:

A tap of one inch diameter with eight threads per inch will be marked:

1" - 8 U.S.S.
G

Machinery

TOLERANCES FOR GROUND THREAD TAPS

Tolerances Proposed by the National Screw Thread Commission (Stock Taps are made Slightly Larger to Meet the Present Demand).

S. A. E. STANDARD

Size	Basic		Tap Measurements					
			Outside Diameter			Pitch Diameter		
	Outside Diam.	Pitch Diam.	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
1/4-28	0.2500	0.2268	0.2520	0.2535	0.0015	0.2268	0.2276	0.0008
5/16-24	0.3125	0.2854	0.3145	0.3160	0.0015	0.2854	0.2862	0.0008
3/8-24	0.3750	0.3479	0.3770	0.3785	0.0015	0.3479	0.3487	0.0008
7/16-20	0.4375	0.4050	0.4400	0.4415	0.0015	0.4050	0.4058	0.0008
1/2-20	0.5000	0.4675	0.5025	0.5040	0.0015	0.4675	0.4683	0.0008
9/16-18	0.5625	0.5264	0.5650	0.5665	0.0015	0.5264	0.5272	0.0008
5/8-18	0.6250	0.5889	0.6275	0.6290	0.0015	0.5889	0.5897	0.0008
11/16-16	0.6875	0.6469	0.6905	0.6925	0.0020	0.6469	0.6477	0.0008
3/4-16	0.7500	0.7094	0.7530	0.7550	0.0020	0.7094	0.7102	0.0008
7/8-14	0.8750	0.8286	0.8780	0.8800	0.0020	0.8286	0.8295	0.0009
7/8-18	0.8750	0.8389	0.8780	0.8800	0.0020	0.8389	0.8398	0.0009
1 -14	1.0000	0.9536	1.0030	1.0050	0.0020	0.9536	0.9545	0.0009
1 1/8-12	1.1250	1.0709	1.1290	1.1310	0.0020	1.0709	1.0719	0.0010
1 1/4-12	1.2500	1.1959	1.2540	1.2560	0.0020	1.1959	1.1969	0.0010
1 3/8-12	1.3750	1.3209	1.3790	1.3810	0.0020	1.3209	1.3219	0.0010
1 1/2-12	1.5000	1.4459	1.5040	1.5060	0.0020	1.4459	1.4469	0.0010

LEAD TOLERANCE

A maximum lead error of plus or minus 0.0005 inch in one inch of thread is permitted.

MARKING

Taps will be marked with the diameter, number of threads per inch, and standard. A symbol indicating ground thread is also recommended, for example:

A tap of one inch diameter with fourteen threads per inch will be marked:

1" - 14 S.A.E. Std.
G

Machinery

RADIO LICENSES REQUIRED IN AUSTRALIA

A novel method has just been adopted by the Australian Commonwealth wireless authorities for protecting broadcasting stations, says a report to the Department of Commerce from Assistant Trade Commissioner Elmer G. Pauly, Melbourne. The regulations recently promulgated require that every prospective purchaser of a receiving set must present to the radio goods dealer a certificate of license showing that he has subscribed to the service of the station operating on the wave length to which the instrument being purchased is adjusted. If a radio enthusiast desires to "listen in" on additional programs, he can have his receiving set so adjusted, but only on the production of certificates showing that he has made separate subscriptions to each. At a recent conference of Federal authorities, manufacturers, broadcasting companies, and dealers, the adoption of a uniform device for sealing receiving sets was decided upon. While the sealed set regulations may be defeated by certain owners of receiving sets, the Government has authority to make surprise inspections of every set to see that the seals have not been tampered with. It is understood that the sealing device which is added locally will in no way interfere with the sale of American radio sets in Australia.

The Machine-building Industries

UNFORTUNATELY, the industrial machine receives little assistance from the Government either in helping to start it or in keeping it running; but frequently the activities or inactivities of our elected representatives at Washington put the brakes on industrial activities. This, we regret to state, has been the case during the last month, and the hesitancy evident on the part of industrial leaders is due to political uncertainty more than to any other single cause.

As a matter of fact, the year started out with great promise. Production rose to higher levels than it had reached during the second half of 1923, and employment in industrial establishments increased. The increases in production were especially noticeable in pig iron and steel ingots. Lately, however, producers of practically all commodities have been more cautious, as is evidenced by the fact that car loadings, which were at record figures until five weeks ago, have dropped slightly during the last few weeks. What is needed is an effective house-cleaning in Washington, and then, within the near future, constructive legislation on important measures now before Congress. This would do more than anything else to restore confidence and would permit business to resume its normal pace.

The Machine Tool Industry

The uncertainty in the general business situation naturally reflects itself immediately in the machine tool industry, where business during the last month has generally shown a falling off, except in the special high-production machinery line, which still continues active. Some machine tool builders have been able to obtain increased foreign business, and in spite of unfavorable foreign exchange and the political uncertainty in Europe, some export orders have been received from countries most affected by these conditions, like France and Russia. Machine tool builders are meeting the situation caused by decreased demand by immediately reducing output so as to prevent the accumulation of excessive stocks. The railroads, awaiting the action of Congress on bills that have been introduced in the present session, are not buying as readily as was expected.

In the small tool field conditions are more satisfactory, the industry, as a whole, operating at about two-thirds capacity, with a few shops having practically all the work they can handle. In the tap manufacturing field, almost every maker of threading tools is developing means for grinding in the threads after hardening, this being the outstanding feature in engineering development in that field.

Transmission manufacturers in general operate at about two-thirds capacity. They find dealers very conservative in placing stock orders, and buying is from hand to mouth. The gear manufacturing fiel is in at least as good a position as any of the other branches of the machine-building industry, and several of the gear-cutting shops state that present business is better than it has been for several years.

The Automobile Industry

A slight reduction is noted in the output of the automobile plants. The March production was about 356,000 cars, which is about 3 per cent less than the output in February, but slightly in excess of the output during March a year ago. It is believed that the April output will be still further curtailed, since it is generally admitted that buying so far this year has been less than what had been anticipated. Some manufacturers, however, do not plan curtailment of production. The Ford Co., for example, is operating at maximum capacity, and the General Motors Corporation reports sales of 211,000 cars and trucks during the first three months of this year, as compared with 176,000 cars during the same period last year.

Fears have been expressed that the automobile industry may prove to be the weakest link in the present business structure. Those speaking for the industry, while admitting that production in the Detroit district has been curtailed, do not consider this a serious indication. They point out that a curtailment of output after reasonable stocks have been built up is evidence of the sanity of the industry, and demonstrates that haphazard policies due to too great optimism have been abandoned. They stress the fact that the passenger car industry has been running at capacity for twelve months, and for the first time in several years has accumulated a surplus of cars not required to meet immediate demands. The output of passenger cars for the last twelve months was 3,750,000. No one familiar with the conditions expected this pace to continue indefinitely, and the industry as a whole does not expect to see the total production during this year equal that of 1923. The output is still maintained at figures that have never before been equalled except last year, when manufacturers found themselves unable to meet the spring demand. This year they have anticipated the demand instead of waiting for it to actually develop. Stocks in the dealers' hands are smaller than usual; hence the stocks at the factories are larger.

These views, as expressed by representatives of the automotive industry, appear sound. In addition, it might be mentioned that the general tendency toward doubt caused by the political situation naturally would affect the automotive industry the same as every other industry.

The Bureau of Public Roads states that on December 31, 1923, the automobile registration of this country totaled 15,092,177, an increase of 2,853,802 during the year, this being the greatest increase that has ever taken place in any one year. Incidentally, the bureau mentions that gasoline taxes are now imposed in thirty-five states in the union, amounting to from 1 to 4 cents a gallon.

The Iron and Steel Industry

The March production in the iron and steel industry was unusually high, being practically equal to the record production of April, 1923, but it is generally felt that March will mark the peak production for the present year. A falling off in orders was particularly noticeable early in April, but very few cancellations have been received. Hand-to-mouth buying is evident in this as in every other field. The United States Steel Corporation has been producing at approximately 96 per cent of its theoretical capacity, which is practically its maximum output. The independent steel companies have averaged around 86 per cent of capacity, making the March average for the entire steel industry about 90 per cent of its possible output.

It should be noted, however, that while production in March was ahead of that in February, the buying fell behind. Hence, there is no sign of any price advances in this field, and buyers naturally see no reason to make contracts far in advance of present requirements.

As far as the general business situation is concerned, there is nothing whatever alarming in present conditions. It is true that the political situation is unsatisfactory and makes the business man hesitate, but this hesitancy is merely a mark of good business judgment and caution and will have no serious effect on the permanent industrial structure. We are in a presidential year, and the party in power is on the defensive, but economic laws survive all the failures and successes of political parties and production and consumption are in the long run quite independent of politics.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Landis Hydraulic Grinding Machine

A NEW high-traverse high-production grinding machine, designed primarily for use on work up to $1\frac{1}{2}$ inches in diameter, but accommodating work up to 6 inches in diameter, has recently been brought out by the Landis Tool Co., Waynesboro, Pa. The machine is built in two sizes, one handling work up to 20 inches in length, and the other up to 30 inches in length. A departure has been made from the usual Landis design in that the grinding wheel head is stationary, while the work carriage is traversed. This construction has been adopted, because a grinding wheel of unusually large diameter, with a correspondingly heavy wheel-head, is used. It is preferable, therefore, to traverse the work carriage, which is the lighter weight. The carriage slides on two V-guides, which have chilled surfaces that insure alignment regardless of the traverse speed. These guide bearings are thoroughly protected from grit and water, and are lubricated from oil reservoirs equipped with rollers, located at intervals along the bed.

A special hydraulic drive furnishes power for traversing the work carriage at any speed from 6 inches to 40 feet per minute. This drive is controlled by means of a regulating valve located on the front of the machine near the operator. The pressure is applied in the oil cylinder through a lever arrangement which increases the power applied to the traversing carriage, thus permitting a much lower pressure and eliminating excessive packing around the valves and joints. The reversing valve is of the balanced piston type, and is so constructed that a smooth motion is transmitted to the carriage at all speeds, regardless of the length of time that the machine has been standing idle.

A device incorporated in the reversing mechanism permits reversal of the carriage at the highest speed without shock or vibration. The starting and stopping lever at the extreme left is connected to the control valve, so that it is possible, by a slight movement of this lever, to control the traverse by hand, or stop it entirely, if so desired, without stopping the work. Oil pressure is furnished by a geared pump driven from the rear drive shaft seen in Fig. 2, and the entire base of the machine serves as a container for the oil, thus not only eliminating an extra tank, but also adding weight and stability to the machine.

The work speeds range from 150 to 800 revolutions per minute, and are obtained by shifting a single lever at the side of the operator. This lever shifts a key through a series of silent chain sprockets running in oil, and by this means it is possible to obtain instantly any desired work speed. The entire speed-change mechanism is contained in a single unit, and power is supplied to this unit through a belt driven from the rear drive shaft.

A grinding wheel 24 inches in diameter is furnished on this machine, because extensive tests have proved that increased production, along with a greater number of pieces ground per dressing of the wheel, more than offset the high initial wheel cost. In one in tance, where a machine using a 16-inch grinding wheel ground 400 pieces per dressing of the wheel, this new machine averaged over 900 pieces per dressing. It is stated that it has frequently ground as many as 1200 pieces with a single dressing, and at the same time showed an increase in production of from 25 to 35 per cent over machines equipped with the smaller grinding wheel.

The wheel-head is designed especially to accommodate this large-sized grinding wheel, the bearings being of such length and diameter as to furnish a rigid support for the wheel, and being spaced sufficiently far apart to insure alignment at all times. The wheel-spindle is driven by a two-step cone pulley, which compensates for different sizes of grinding wheels. An automatic tightener keeps the grinding wheel driving belt under a uniform tension at all times, regardless of the position of the wheel-head, and, in addition, compensates for any stretch of the belt. Fig. 3, which shows a view of the wheel-head with the driving pulley guard removed, gives an idea of the proportions of this unit.

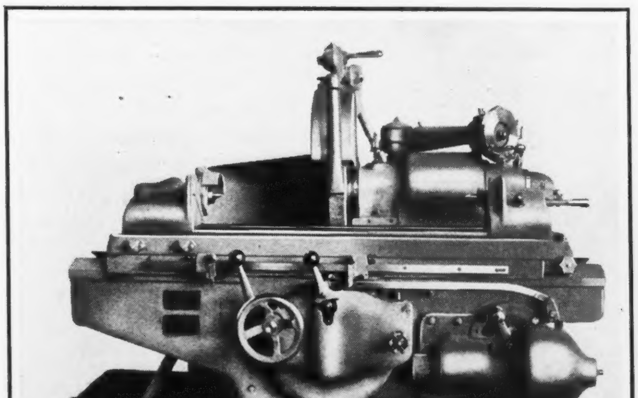


Fig. 1. Landis High-traverse, High-production, Hydraulic Grinding Machine

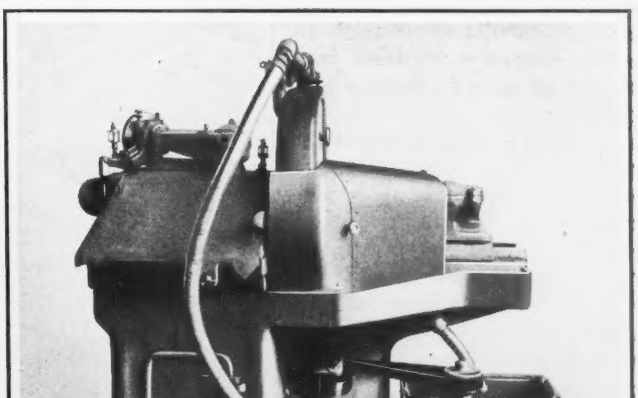


Fig. 2. Rear View of the Landis Grinding Machine showing the Back Drive Shaft

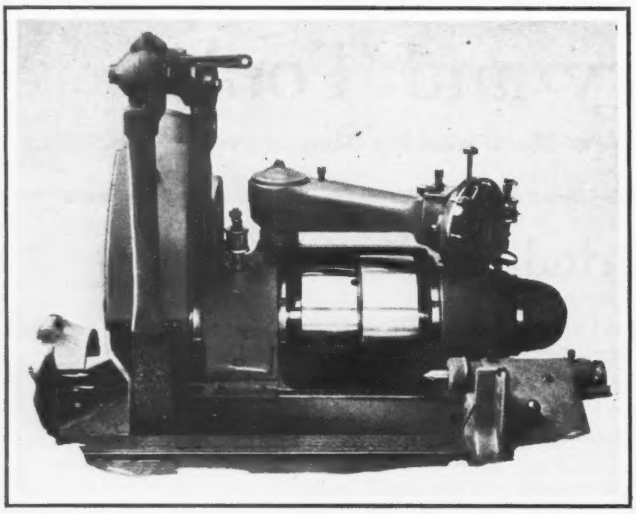


Fig. 3. Grinding Wheel Head with Pulley Guard removed

The grinding wheel feed is either automatic or by hand, this mechanism being the same as on previous designs of Landis machines. This type of feed allows the operator to stand in his natural position, and affords him an unobstructed view of the grinding wheel in bringing it toward the work. Either a lineshaft or motor drive can be provided for the machine. With a motor drive, the motor is direct-connected to the rear driving shaft through a flexible coupling; and with a lineshaft drive, a simple adjustable countershaft equipped with tight and loose pulleys is provided, the drive being through a single belt from this countershaft to the pulley on the rear drive shaft.

GOULD & EBERHARDT AUTOMATIC GEAR-HOBBING MACHINE

A machine designed for hobbing gears up to 72 inches in diameter has recently been brought out by Gould & Eberhardt, Chancellor Ave., Newark, N. J. This machine, which has been designated as No. 72-H, is of the universal type, arranged for automatically hobbing spur, helical, herringbone, and worm gears, and also for milling spur and helical gears and worms. The milling is accomplished by means of a semi-automatic disk-cutter attachment. The machine is rated for cutting teeth up to 1½ diametral pitch in cast iron or up to 2 diametral pitch in steel. Coarser pitch teeth may be cut by taking roughing and finishing cuts.

One of the features is that all the drive, feed, and differential gears are segregated in a case bolted to the rear of the bed, as shown at the right in Fig. 1. This arrangement makes the entire mechanism accessible by simply removing the cover, and also makes it possible to incorporate an automatic gravity system of lubrication. The drive-shafts for the work- and cutter-spindles, the feed shafts for the cutter carriage and stanchion, and the various control rods all extend from this case along the bed of the machine. The change-gears are located outside of the case, but are entirely enclosed by guards.

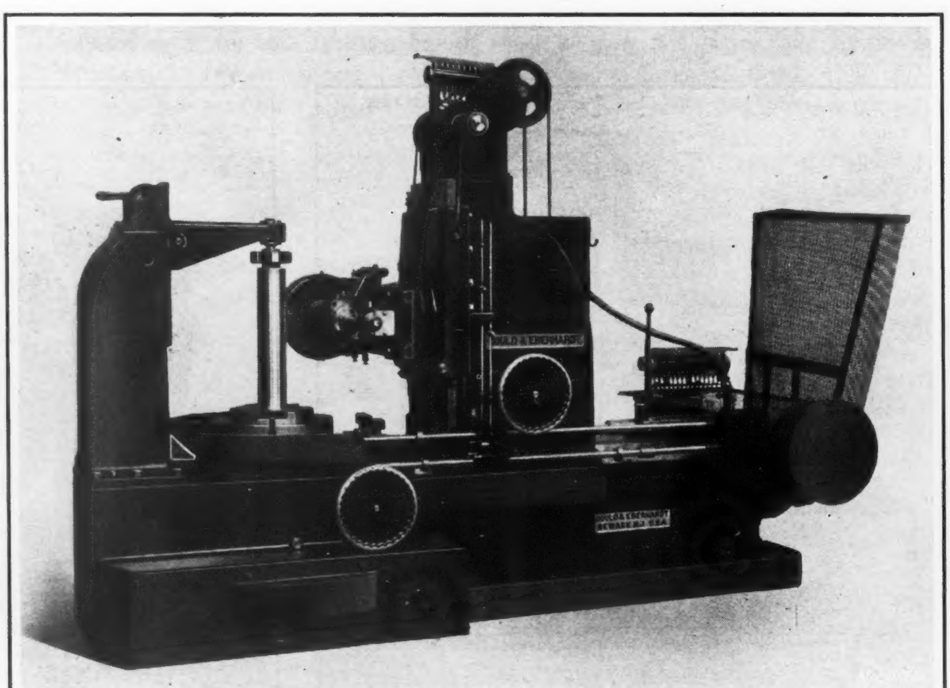


Fig. 1. Gould & Eberhardt Automatic Gear-hobbing Machine

Another feature of the machine is an adjustable type of stanchion arranged to slide on the ways of the bed. This design permits the use of an unusually long, slightly tapered work-spindle, mounted in a large taper bearing in a heavy casting which is bolted and doweled to the bed. The index worm-wheel is located at the bottom of the spindle, while the worm is mounted on a short shaft inside casing *A*, Fig. 2. The worm-shaft is geared to the horizontal index-shaft *B*, which is driven through change-gears. It is possible to cut gears with from 8 to 99 teeth, including the prime numbers, and from 100 to 312 teeth, excluding the prime numbers. By locating the worm-wheel in the base, it is possible to use a wheel 48 inches in diameter and, at the same time, to cut small-diameter pinions without an extreme overhang of the cutter-slide.

There is a 10-inch hole through the center of the spindle from end to end so that gears integral with long shafts may be machined with the shaft inserted in the hole. Such shafts may extend through the floor if necessary. The diameter of the work-spindle head is 21 inches, and there is an auxiliary faceplate 36 inches in diameter for supporting large-diameter gears. The upper end of the work mandrel is supported by the box-section, stanchion type, outer support shown. The bearing *C* is guided on the face of the support, and the arm *D* is counterweighted so that it will slide up and down easily when unclamped. When gear blanks are to be changed on the mandrel, the arm is moved up to the face of part *C*, which is then unclamped and swung around, carrying the arm with it and giving access to the top of the mandrel. The outboard support may be used in cutting gears up to 36 inches in diameter.

The cutter-spindle is mounted in bearings in the swiveling section of the cutter carriage which have independent adjustments for taking up radial wear and end play. The outer or arbor bearing is removable for mounting the cutter, and both bearings can be moved axially. This arrangement is valuable as a means of quickly centering the cutter or hob. A further aid to alignment is a locating gage in a hole at the center of the carriage. This gage is normally flush with the carriage, but it can be easily projected a short distance from the hole when required. The maximum diameter of hob which can be accommodated is 11 inches, and the maximum length, 16 inches. The spindle is driven from a parallel shaft through herringbone gears which are so mounted in bearings and splined to the spindle that the

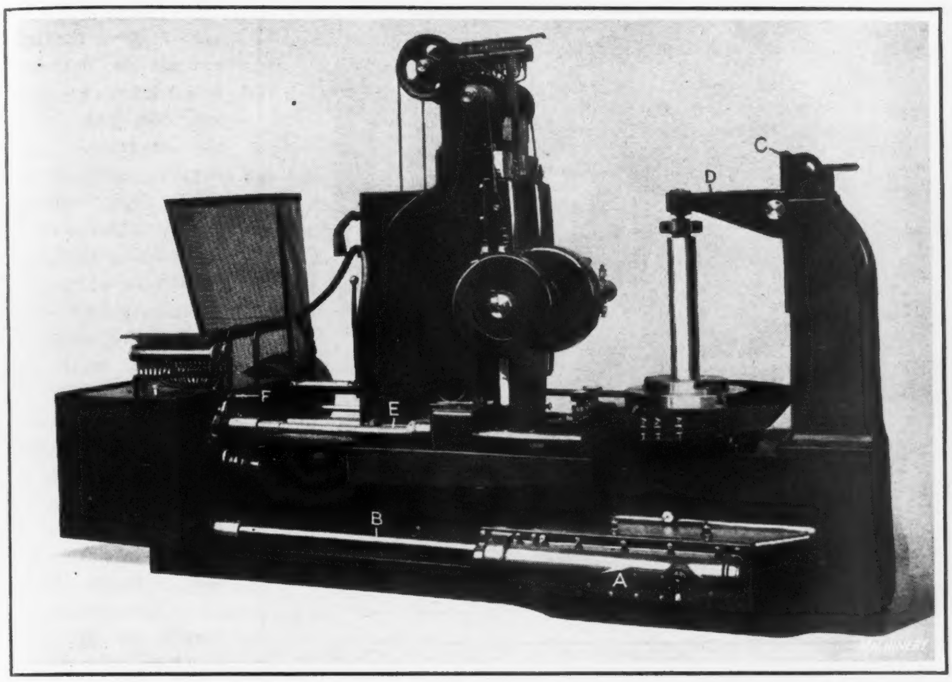


Fig. 2. Rear View of the Automatic Gear-hobbing Machine shown in Fig. 1

latter is not required to resist the thrust of the gears. A flywheel is mounted on a stud at the end of the swivel slide, and driven by spur gears from the end of the parallel shaft which rotate it faster than if it were attached to the cutter-spindle, thus permitting it to be smaller in size.

The parallel shaft is driven by a series of shafts and bevel gears inside the stanchion from the horizontal cutter drive-shaft *E*, which is driven through change-gears that provide ten cutter speeds ranging from 20 to 97 revolutions per minute. The pulley shaft of the machine drives the change-gear shaft through a reversing clutch, and so the direction of the cutter rotation can be changed at will. The proper angular position of the hob is obtained by rotating the swiveling portion of the carriage through a worm and gear. The feed-screw is fastened solidly in the carriage, and the feed-nut is mounted in the stanchion at the top of the ways where it is driven by a worm.

There is a power rapid traverse for the carriage in both directions, in addition to the power feed. Ten cutter feeds ranging from 0.01 to 0.15 inch per revolution of the work-spindle are available. The feed-nut receives its power from a longitudinal shaft located between the ways of the bed, which is driven through the gear-case. There is a sufficient feeding length for cutting gears up to 20 inches face width.

Fixed and adjustable stops for both feed and power rapid traverse of the carriage are provided, as shown in Fig. 1. All control levers are so interlocked that the feed cannot be started until the rapid traverse is stopped, and vice versa. The index-shaft *B*, Fig. 2, is driven from the cutter drive-shaft in the gear-case, and when hobbing spur gears and worm-wheels, directly through the index change-gears. However, when cutting helical teeth, a clutch is set to introduce a miter gear differential into the train. Worm-wheel teeth are cut on the periphery of the differential casing, and it is rotated by a worm, which, in turn, is driven through change-gears from the cutter-feed shaft. This arrangement gives the required lead for helical teeth.

When it is desired to mill teeth by means of the disk cutter attachment, a setting of the index-clutch and a manipulation of handle *F*, after shifting a gear on shaft *B*, allows the indexing of the work by hand for each tooth. The automatic cutter feed is used and the proper lead for disk-cutting helical teeth may be obtained automatically through the differential. The machine itself is driven by a single belt pulley through a friction clutch controlled by the ball-end lever seen at the right of the stanchion in Fig. 1. A coolant pump is geared directly to the pulley shaft and runs at constant speed to deliver the liquid at the cutting point through a flexible hose and wide nozzle. The coolant then returns to a large reservoir in the base. If a motor drive is desired, a 15-horsepower motor may be mounted on a bracket and arranged to drive the pulley shaft through a silent chain. The floor space required by the machine is 60 by 150 inches, and the weight is approximately 18,000 pounds.

NIAGARA POWER FOLDER AND BRAKE

A power folder and brake, which has a working length of 72 inches and handles sheet metal up to No. 14 gage, is now built by the Niagara Machine & Tool Works, 637-97 Northland Ave., Buffalo, N. Y. On this machine a sheet can be bent to a right angle at any distance from the edge, or to a 30-degree acute angle along the edge. Successive bends can be made to form the sheet into closed bodies, such as boxes or square pipe. The machine is especially adapted to the manufacture of ice cans in which ice is frozen, the machine forming the can from a single sheet. Box pipe as small as 11 inches square can be produced from flat sheets and easily removed from the machine without springing or altering the shape of the pipe.

The sheet to be folded is placed on the front brackets and instantly gaged. The operator then steps on the treadle to actuate a clutch, after which the clamping bar comes down

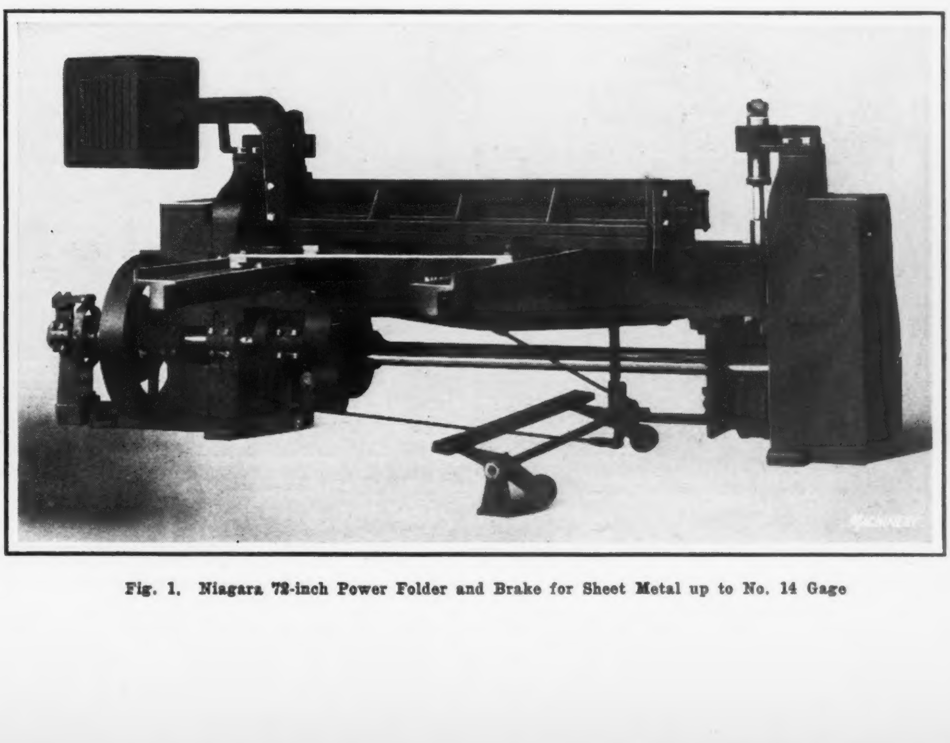


Fig. 1. Niagara 72-inch Power Folder and Brake for Sheet Metal up to No. 14 Gage

and grips the sheets, the folding bar swings up and back to make the desired bend, and the clamping bar returns to its upper position. This completes the first fold, the action being entirely automatic. This operation is repeated four times in making square or rectangular parts.

Gages best adapted to the particular work to be done can be furnished with the folder. In the case of the machine used in making ice cans, a bar provided with two gripping jaws facilitates feeding the sheet into the folder. This bar is guided by grooves cut in steel blocks that are adjustable along the gage brackets. The taper of the can is also taken care of by this method of gaging.

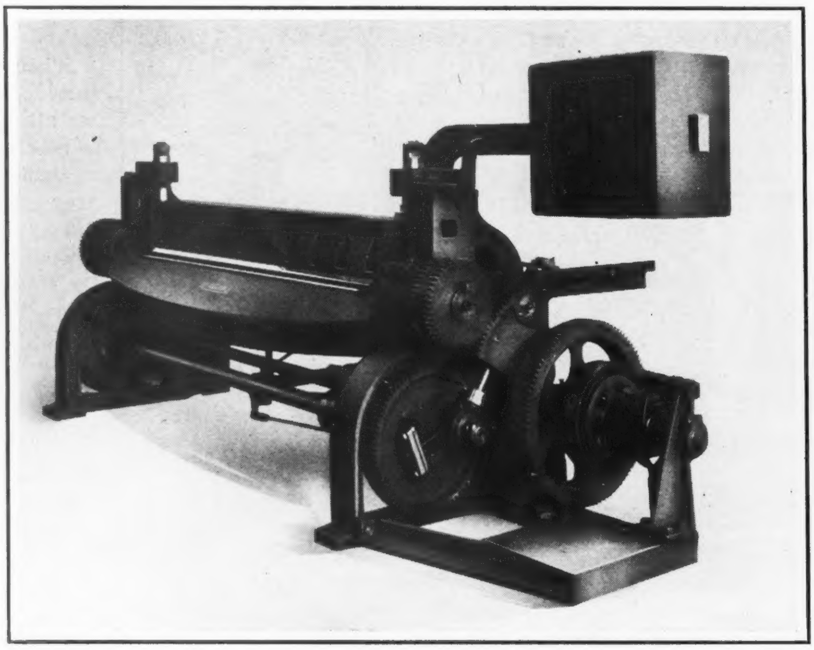


Fig. 2. Rear View of the Folder and Brake, showing the Drive

The drive is of the double back-geared style, the machine illustrated being arranged for an individual geared motor drive. The clamping bar is a steel casting that is guided at both ends by large steel posts which move in brass-bushed bearings. The bar is automatically moved up and down by means of toggle links that are operated by cams on the main shaft, the action being properly timed with that of the folding bar.

The left end of the clamping bar is pivoted about the guide post and so arranged that the right end can be swung out to permit removing the work formed around it. A single latch at the right-hand guide post makes it possible for the operator to easily unlock and open the bar. The latter is counterbalanced and the left post supported by ball and roller bearings, so that practically no exertion is required to swing the bar out. When swung back into place, it locks itself in position. An adjustment provides for regulating the pressure on the sheet, and a safety device is incorporated in the machine to prevent engagement of the clutch when the clamping bar is open. Both the clamping and the folding plates can be designed to suit special work.

The folding bar is also a steel casting, and it is actuated by twin segment gears on each end of the machine. These segment gears receive their oscillating motions from adjustable crankpins mounted on the drive gears and cause the bar to turn over to the desired angle and back in one revolution of the main shaft. The angle of the fold is regulated by shifting the crankpins in the T-slots on the sides of the gears and by adjusting the length of the connection rods which actuate the segment gears. The floor space required for this machine is 12 feet 8 inches by 7 feet 8 inches, and the shipping weight is about 12,000 pounds.

AMERICAN SUPER-PRODUCTIVE LATHE

A 36-inch super-productive heavy-pattern lathe equipped with a patented eighteen-speed geared head and arranged for either a belt or motor drive is being placed on the market by the American Tool Works Co., Cincinnati, Ohio. When belt-driven, 35 horsepower is delivered to the driving pulley, and for a motor drive, a motor of from 20 to 45 horsepower is recommended. Probably the most important improvement is a new faceplate drive, which furnishes twelve of the eighteen spindle speeds through the internal gear in the faceplate. Thus, only one-third of the speeds, or six, are transmitted through the spindle gear, and as a result, in all severe turning operations the drive is through the internal gear. The twelve speeds obtained through the faceplate drive range up to 32½ revolutions per minute inclusive, which, with 6-inch diameter work, gives a lineal speed of 50 feet per minute.

The entire range of spindle speeds is obtained through sixteen gears, including the faceplate internal gear and

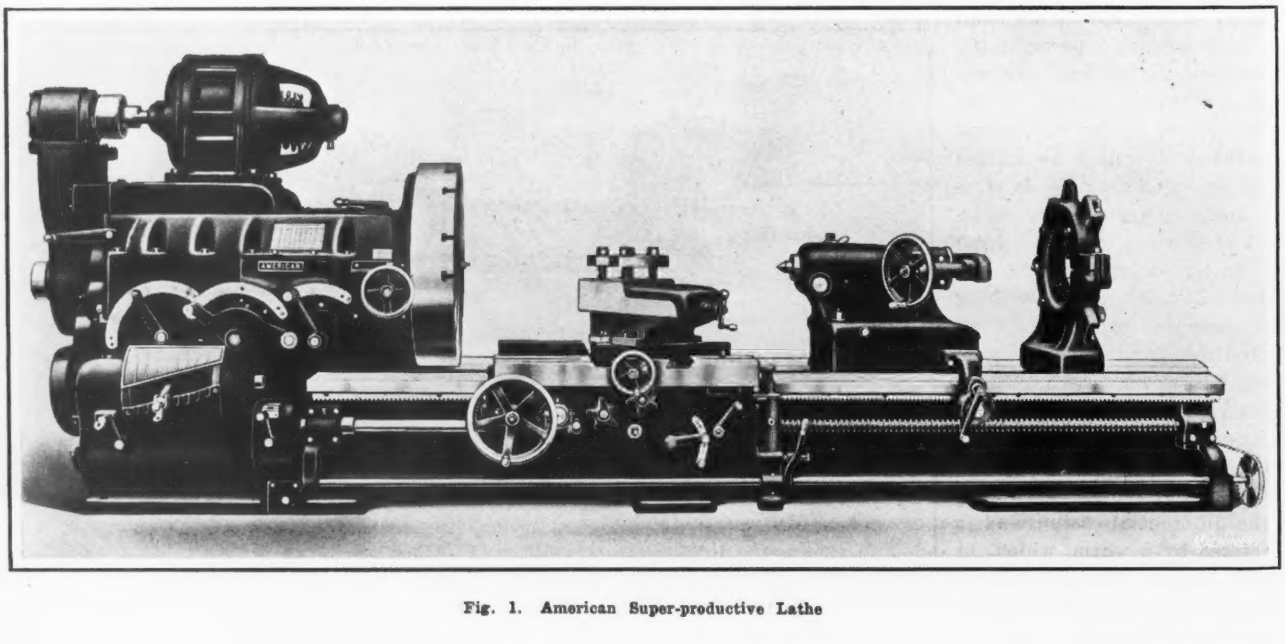


Fig. 1. American Super-productive Lathe

pinion, without the use of friction or jaw clutches. All changes are made through slip gears, the only ones in operation at any time being those that are actually transmitting power. By removing certain driving units, the head can be simplified for use with an adjustable-speed motor, six mechanical speeds being then furnished.

The automatic oiling system used on the smaller sizes of lathes built by this company has also been incorporated in the new head, as shown in Fig. 2. A gear-driven pump delivers oil from a reservoir at the bottom of the head to a distributing chamber in the top cover. Before reaching the bearings, the oil must pass through a felt filtering pad in the distributing chamber, and it then drips into small reservoirs from which it is fed through tubes to the various bearings. Each tube has its individual reservoir so as to prevent any one bearing from absorbing the oil intended for another. An overflow from the distributing chamber lubricates the gears, after which the oil drains back into a settling basin from which it overflows into a primary filtering chamber. It is then drawn through a fine, wire mesh filter and again pumped to the top of the head.

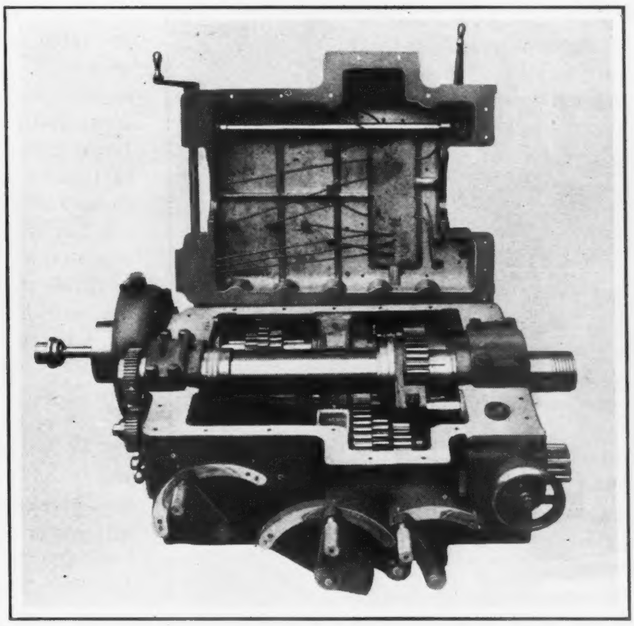


Fig. 2. Headstock with Cover raised to show Method of Lubrication

When motor-driven, the motor is mounted on the headstock and connected with the initial driving shaft by herringbone gears. A flexible coupling between the motor and the driving pinion compensates for end movement of the armature shaft. The motor pinion is mounted on SKF double-race self-aligning ball bearings, and the whole unit is enclosed.

The starting clutch and brake are incorporated in a detachable unit, which is located in the driving pulley of belt-driven lathes and in the large motor gear of motor-driven lathes. There is a mechanical apron control for operating the starting clutch and brake. For variable-speed motor-driven lathes having a fairly long bed, it is desirable to equip the machine with an electrical apron control, to enable the operator to start, stop, reverse, and vary the motor speeds from the apron position. The bed has been considerably widened and otherwise strengthened, and the tailstock and carriage have been increased in width to suit. The spindle-adjusting handwheel of the tailstock has been placed near the front and is connected to the spindle through an angular shaft and bevel gears. A power rapid traverse for the carriage may be applied either when the machine is built or after installation, the carriage mechanism being arranged to receive it. The rack pinion may be withdrawn from the rack, which is a desirable feature in cutting coarse-pitch threads.

Renewable bushings are fitted into every cylindrical member subject to wear, which applies to all bearings, sleeves, loose gears, etc. The quick-change gear mechanism provides a wide range for screw-cutting, but the range may be increased through the auxiliary quadrant on the head end of the bed. The quick-change gear mechanism is a separate unit which is readily accessible and may be quickly detached.

Some of the important specifications are as follows: Swing over bed, 40½ inches; swing over carriage, 27½ inches; maximum distance between centers, with a 12-foot bed and the tailstock flush, 4 feet 6 inches; range of spindle speeds, 1.82 to 157 revolutions per minute; number of thread and feed changes, 48; feed, in number of turns per inch, 3.5 to 196; and weight, with a 12-foot bed, 23,050 pounds.

S. & S. BEADING, CURLING AND TRIMMING MACHINE

For beading and trimming all kinds of drawn shells and cups, such as automobile hub and radiator caps, the S. & S. Machine Works, 4522 W. Lexington St., Chicago, Ill., has recently placed on the market the No. 4 heavy-duty machine shown in the accompanying illustrations. This machine was designed to bead and trim brass shells ⅛ inch thick up to 10 inches in diameter. It is of heavy construction throughout, the spindles being 2⅛ inches in diameter, and the main shaft 2¼ inches. A driving belt 4 inches wide is used. In order to show the arrangement of the gearing, the guards were removed at the time that the photograph reproduced in Fig. 2 was taken.

The spindles run continuously, the operator placing the work on the chuck and depressing the treadle to operate a

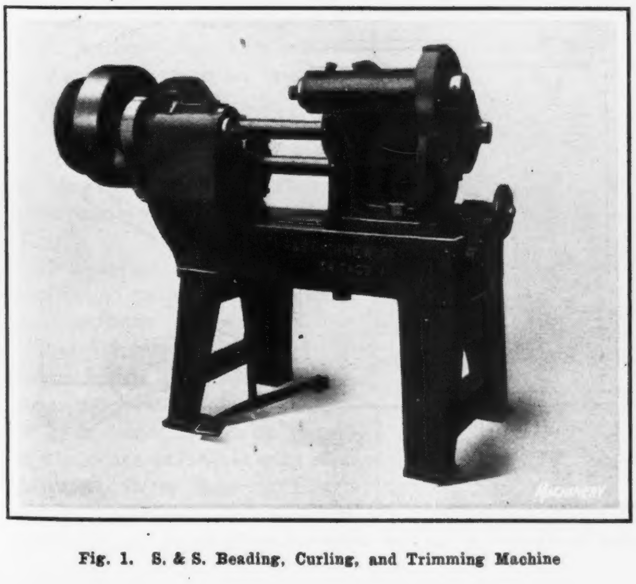


Fig. 1. S. & S. Beading, Curling, and Trimming Machine

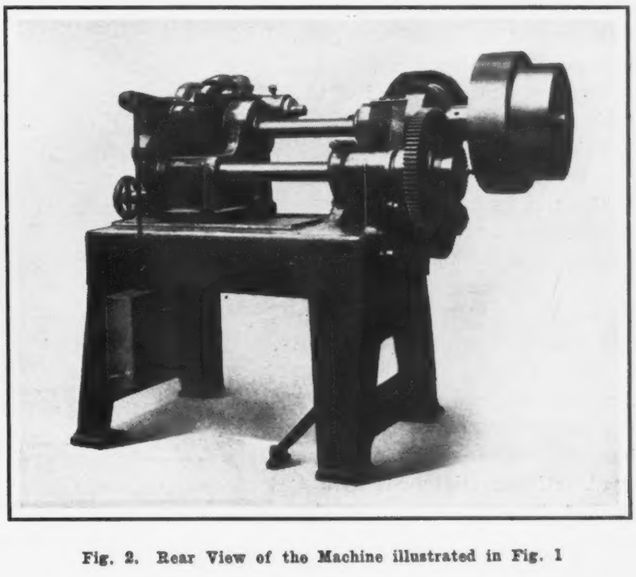


Fig. 2. Rear View of the Machine illustrated in Fig. 1

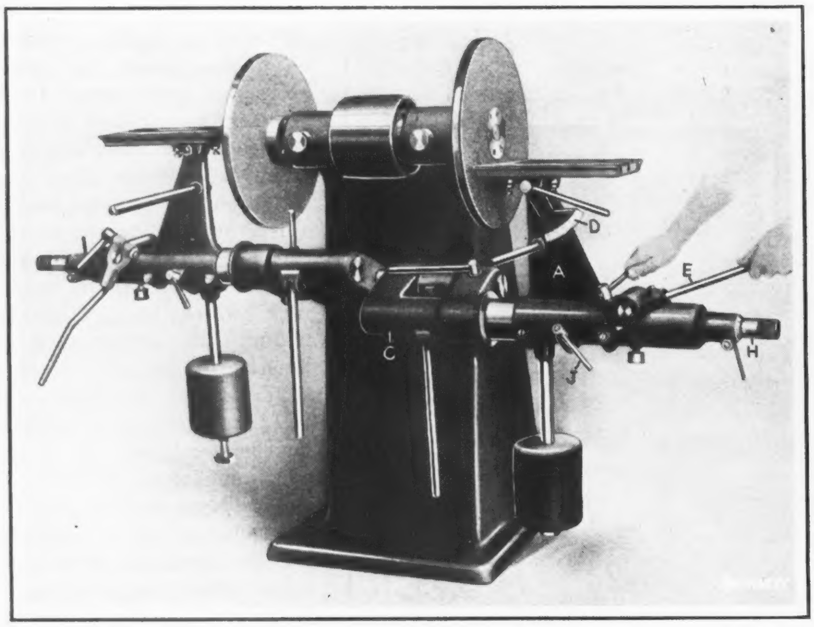


Fig. 1. Carpenter Disk Grinder

clutch on the back-shaft. There is a cam on the back-shaft that automatically swings the arm casting to carry the beading and trimming roll into contact with the work, (the pressure being gradually applied), and then moves the roll away from the work. After the roll has been moved away, the back-shaft comes to a stop, until the operator again depresses the treadle. A thread adjustment provides for quickly setting the machine to suit different diameters of work, and the cone pulley permits a change in speed and power.

CARPENTER DISK GRINDER

One of the principal features of a duplex disk grinder now built in 18- and 20-inch sizes by the Carpenter Engineering & Machine Co., 522 Corn Exchange Bldg., Minneapolis, Minn., is the table raising, lowering, and feeding mechanism. The main claims made for this design are that no bearing surfaces are exposed to grit or other dirt and that the tables can be adjusted to any height within three seconds, or accurately set to any angle within five seconds time. Each table arm or carriage *A* is mounted on a long bar *B*, Fig. 2, which is rigidly held in the outer bearing of the U-shaped link *C*, Fig. 1. The inner bearings of this link pivot on a stationary stud attached to the column. The link is clamped, by means of the handle on top of one of the rear bearings, in the proper angular position on the stud for setting the table at any desired height. The long lever extending vertically from the link toward the floor facilitates making this adjustment.

The extreme upper end of the table arm *A* is forked to receive a finished lug on the bottom of the table, the table being held to the arm by means of a clamping bolt, rear collar, and the combined collar and quadrant *D*. In tightening the handle of the clamping bolt, four surfaces are secured together to insure a rigid support for the table. Angular settings of the table are accurately made by bringing the graduations on the quadrant into alignment with a scribed line on a lug on the arm *A*.

In feeding work against the disk wheel, the table and arm *A* are moved as one unit on rod *B*. The arm telescopes into link *C*, as shown in Fig. 2, so as to prevent dirt from getting into the bearings of the arm. Lever *E* is operated toward the disk wheel, in feeding the arm and table in that direction. The movement of the lever causes the rotation of a pinion *F*, Fig. 2, which is mounted on the same shaft as the lever, the teeth of the pinion meshing with those of the rack bushing *G*. As lever *E* is moved forward the pinion travels along the rack until the table and table arm have been moved sufficiently along bar *B* in the direction of the disk wheel to bring the inner end of micrometer *H* into contact with the outer end of bar *B*. The internal end of the micrometer thus serves to control the movement of the table and table arm toward the left, and establishes the minimum distance between the table and the disk wheel. This gives an accurate control of the dimensions to which parts are being ground. The micrometer is graduated in thousandths of an inch, and may be clamped in any setting by applying the short lever directly beneath it. Rack bushing *G* is prevented from moving by the shoulder on bar *B* and by the washer and nut at the opposite end, but it is allowed to oscillate upon the bar in unison with arm *A*.

Lever *E* may be clamped in various positions on the shaft of pinion *F* by means of the binder handle on the lever. It takes only about three seconds to change the lever from the horizontal position, where it is used in ring-wheel grinding, to the vertical position for light disk-wheel grinding. The rack bushing is prevented from rotating by a key and pin. Lubrication of the operating members is provided for by means of grease cups. The short lever *J* is used for clamping the table arm in any position. The wheel-spindle is $2\frac{1}{8}$ inches in diameter, and revolves in radial ball bearings, the end thrust being also taken by ball bearings, so installed as to be adjustable for wear. No adjustment of the weight is required to compensate for changes in the elevation of the table. Both sizes of this machine weigh about 1500 pounds.

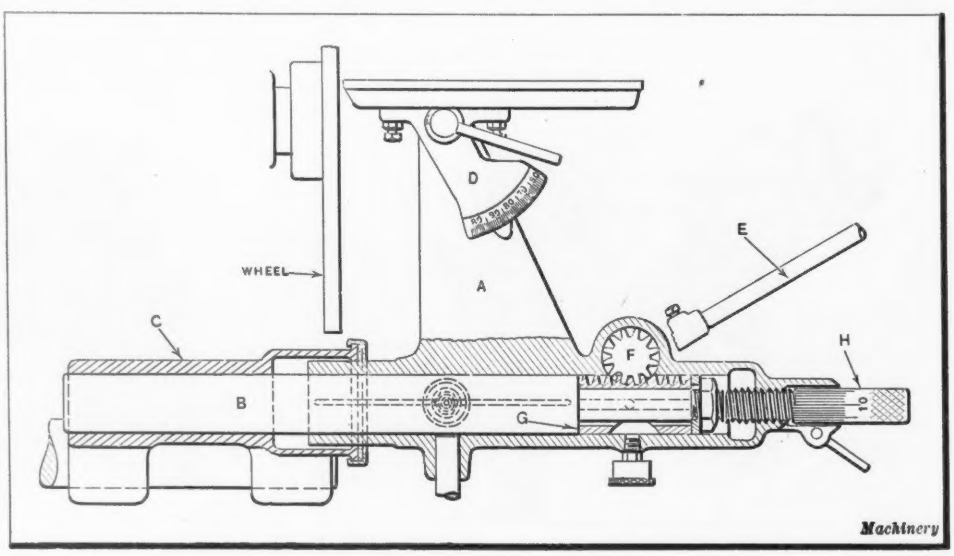
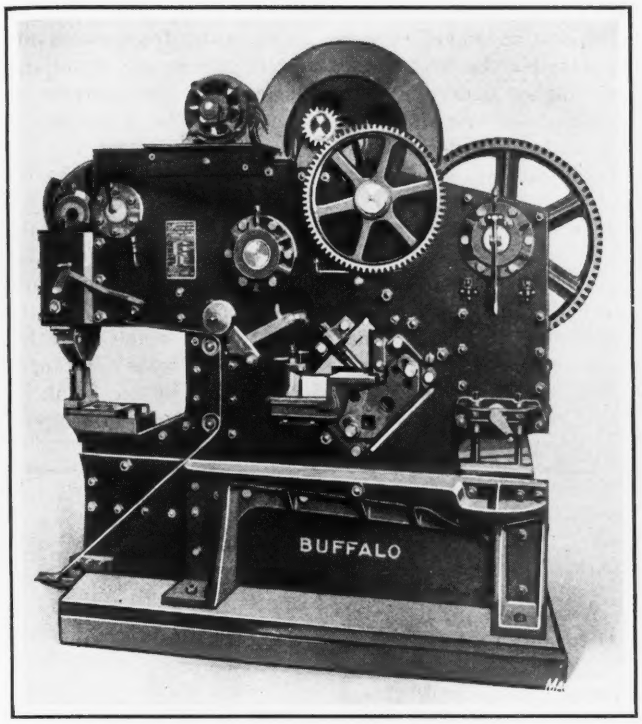


Fig. 2. Table-feeding Arrangement of the Disk Grinder shown in Fig. 1

BUFFALO SLITTING SHEAR, PUNCH AND BAR CUTTER

A new series of triple combined slitting shear, punch, and bar cutter has been brought out by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. These machines are equipped



Buffalo Improved Slitting Shear, Punch, and Bar Cutter

with a diagonal bar-cutter plunger, and are enlarged in capacity and reduced in size over older machines of the same type built by this concern. In two small sizes of the series, there is but one plunger for both the bar cutter and the slitting shear, whereas in the larger universal machines there is a separate plunger for each of these mechanisms.

Chief among the points wherein the new machines have been improved over past designs is the mitering arrangement. With the old style mitering attachment it was necessary to move the stripper screw for each different angle of square cutting, but in the new design the stripper screw is universal and requires no adjustment. As the diagonal bar cutter is universal, angle-irons can be mitered or beveled in the horizontal plane. Without this feature, lifting and twisting would be necessary to obtain the proper inclination for the cut.

The three large cast-iron main gears used in the old machines have been displaced by steel gears and nickel-steel pinions, which reduces both their size and weight. The side bracket used for supporting plates in slitting operations is also improved in that the bracket and two supporting legs are cast in one piece. The older type was made without legs and merely bolted to the machine. Another improvement which facilitates the operation of the machine is the placing of the shear clutch on the operating side, whereas it formerly was on the gear side.

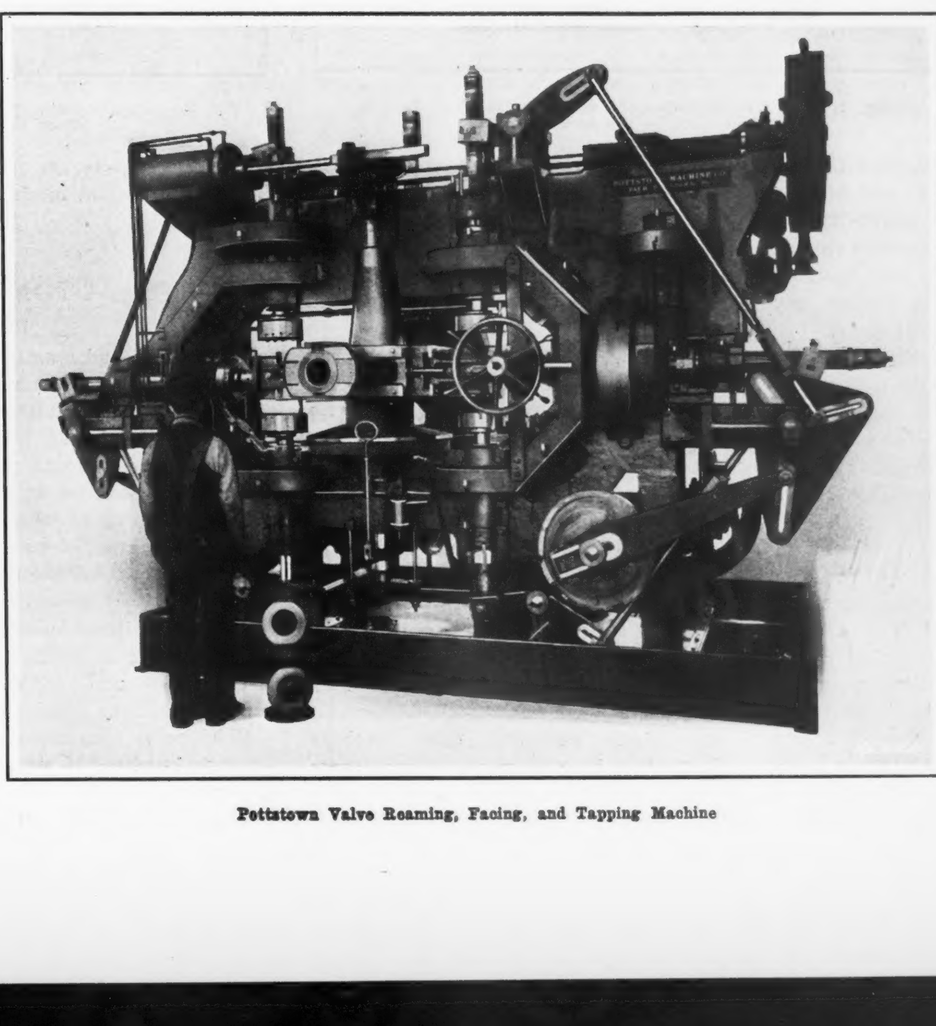
This series of machines is made with an extra high throat for handling I- and girder-beams, channel irons, and H-columns. The semi-floating punch is engaged either by the handle or by a foot-treadle. By means of die-blocks furnished with each machine, it is easy to punch structural shapes of any standard size through the web and flanges. Holes can be punched in any part of the web without turning the section over. The bar cutter is engaged by shifting the ram by means of a counterweighted lever. Fixed stops are used for shearing to angles, squares, or 45-degree miters without requiring marking of the angles. The punching capacity of the new series ranges from 1-inch holes through ½-inch plate for the smallest machine, to 1¾-inch holes through 1½-inch plate for the largest. The capacity for slitting ranges from ½- to 1½-inch plate.

POTTSTOWN VALVE FINISHING MACHINE

A machine for automatically reaming and tapping globe valves, cocks, and similar fittings, has just been brought out by the Pottstown Machine Co., Pottstown, Pa. This machine is designed to handle from 2- to 6-inch standard globe valves. There are eight spindles which hold roughing, reaming, and facing tools in any combination desired. At the rear of the machine are two spindles which are used for finish-seating, whether the work is an angle or globe valve. The three spindles on the right-hand side of the machine are interchangeable, and can be used for tapping or reaming and facing. The automatic reversing mechanism is thrown in for the taps by simply shifting one gear, the mechanism being adjustable to suit all sizes.

There are four work-holding chucks into which the work is successively placed as they reach the operator, while cuts are being taken on the work in the remaining three chucks. The indexing of the turret is controlled by an air valve on the upper left-hand corner of the machine. The moment a latch bar is operated, this valve automatically starts a cam mechanism, which makes one complete turn or cycle, after which the machine comes to a standstill to permit the chucking step to be repeated. The length of travel of the spindles is adjusted by means of wrist-plates with elongated slots in them. Each spindle may be individually adjusted while the machine is in operation.

This equipment is driven by a 35-horsepower, adjustable-speed motor, and it can be furnished with a rotary pump and system for delivering cutting compound to the tools. It is easily set up for different pieces of work, because it is possible to take out any tool without disturbing others



Pottstown Valve Reaming, Facing, and Tapping Machine

of the set. It takes only four minutes to finish a 6-inch globe valve complete, including cutting the seat or threading the valve to receive a seat ring. The operator ordinarily stands on a platform which is not shown, but if a platform is not desirable, the machine base can be under the floor. The floor space required is 17 feet by 10 feet 3 inches, and the height of the machine is 11 feet 6 inches. It weighs approximately 46,000 pounds.

BARNES DRILL CO.'S AUTOMATIC DRILLING AND TAPPING MACHINES

An automatic drilling machine, an automatic tapping machine, and a combined automatic drilling and tapping machine are being introduced to the trade by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill., in three sizes of 20-, 22-, and 24-inch swing, respectively. The 22-inch size is of a heavy-duty type. These automatic machines embody the essential elements of the all-geared, self-oiled machines built by this company, and, in addition, have an automatic spindle control and either a self-indexing or a hand-indexed work-table.

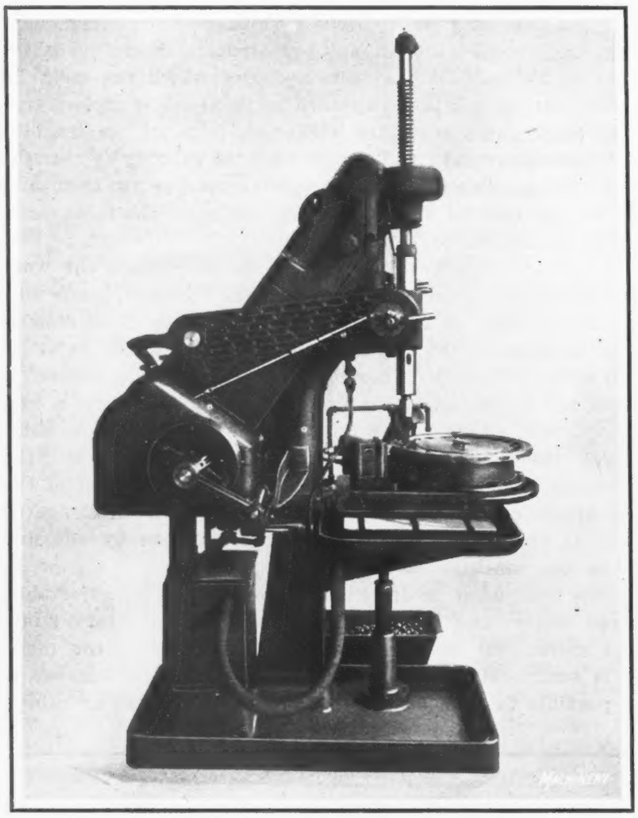


Fig. 1. Automatic Self-oiling All-geared Drilling and Tapping Machine built by the Barnes Drill Co.

Fig. 1 shows the automatic tapping machine equipped with a twenty-position self-indexing work-table arranged for holding conduit bushings. The work-table is provided with self-closing jaws which hold the work securely at the machining station, the outer jaw being closed by a roller. As the table rotates past the tool, the jaws automatically release and permit an ejector to knock out the finished piece. Thus the operator only has to keep the stations filled with blanks, as everything else is automatic. The production ranges up to 25 pieces per minute, depending on the size of the work and the depth to which it is tapped. It will be seen that the column is of square construction and that a coolant pump is supplied. The self-indexing work-table may also be furnished with ten stations.

Fig. 2 shows a two-spindle automatic gang machine equipped for fast production on heavier work, such as parts of malleable-iron unions. Each main spindle is fitted with a four-spindle auxiliary head, and there is a four-station hand-indexing rotating work-table for each head. For all two-operation work, such as union nuts, four pieces are bored under the first head and four pieces are simultaneously tapped under the second head, while the operator reloads at least one of the spare stations. The work-table is then indexed 90 degrees and the operations repeated.

Less than two seconds time is required to index the fixture, as it rotates on ball bearings, and the instant the fixture is located under the spindles, the tools approach automatically and enter the work. When the predetermined depth of feed has been reached, the spindles automatically return to their upper position where they remain until the operator again indexes the fixture. With single-operation work, such as pipe ends of unions, eight pieces are tapped at the same time that the two spare stations are being reloaded, and the work-table is then indexed 180 degrees.

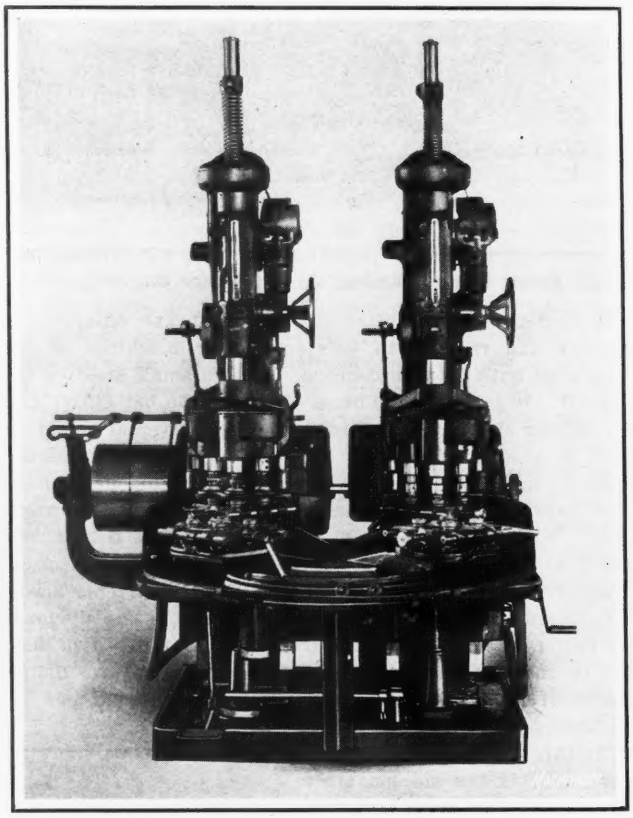


Fig. 2. Automatic Two-spindle Machine equipped with Auxiliary Heads and Four-station Tables

Facing operations are also accomplished automatically by means of a special mechanism that can be embodied in the machine.

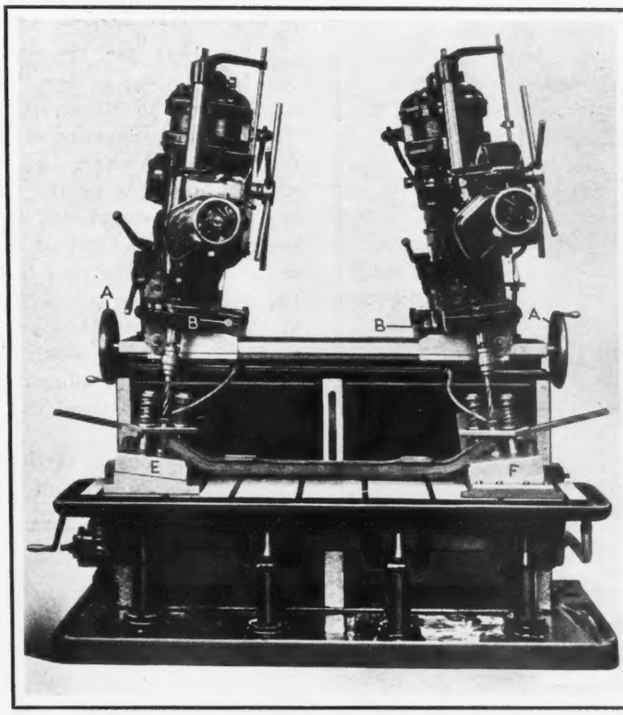
MINSTER AUTOMOBILE AXLE DRILLING MACHINE

For drilling and reaming the king-bolt holes in automobile front axles, the Minster Machine Co., Minster, Ohio, has recently built the duplex machine here illustrated. Two single-spindle drilling machine units are mounted on the bed of the machine to provide for simultaneously drilling or reaming the holes at the opposite ends of the axle. The two units are mounted on saddles which may be slid along a planed bearing so as to vary the distance between the spindle centers, by turning handwheels *A*. As the holes in the work are at an angle, it was necessary to provide for setting the drilling spindles at an angle. Thus each of the machine units is pivoted at *B*, and furnished with an adjusting screw and vernier by means of which the required angular positions can be obtained.

As there is considerable variation in the lengths of the forgings handled, it was found desirable to furnish means of compensating for such inequalities. This is provided for by the fixture on the table, which consists of blocks *E* and

F; block *E* slides longitudinally on the ways of a bed-plate bolted to the table, leaving the upper member free to adjust itself to suit the end of the forging. Both drill bushings have an inverted cup at the lower end which seats itself over the forging and they are mounted in a plate which is held down on the forging by springs. A cup-shaped member is also furnished on the top surface of jig blocks *E* and *F*. In loading the fixture, the forging is dropped into these cups, after which the springs force the upper cup-shaped bushings on the work and secure it in place.

Individual hand-levers are furnished for raising the bushings from contact with the work when removing finished pieces to replace them with new forgings. As the machine was finally set up for operation, a single foot-treadle was used to raise the cups from both ends of the forging, this construction leaving the hands of the operator free for handling the work. The two drilling units on this machine are the standard No. 9 type built by the company mentioned. Each unit is equipped with an electric motor mounted on top of the column and direct-geared to the machine to insure positive transmission of power.



Minster Automobile Axle Drilling and Reaming Machine

LAMBERT EXPANSION REAMERS AND BORE-REAMERS

A new line of expansion reamers and bore-reamers is being placed on the market by the Lambert Tool Co., E. 55th St. and Euclid Ave., Cleveland, Ohio, in sizes from 1 to 20 inches, or larger. The difference between the expansion reamers and the bore-reamers is that the latter are provided with three tools *A*, Fig. 2, which rough-bore the hole before the reamer blades *B* are used. These reamers are supplied mounted on bars as shown, or without bars, as desired. The bar of the cutter shown in the upper part of Fig. 1 has a taper shank. This is a line boring and reaming tool. The reamer at the bottom of the illustration is suitable for use on the average machine.

The range of expansion of these reamers is from ¼ inch on the smallest size to 6 inches on the largest; a reamer 3 inches in diameter, for example, may be expanded 1 inch. The expansion is accomplished, after loosening the lock-nut, by simultaneously turning the graduated scrolls with a special wrench, until the desired diameter is reached, after which the lock-nut is again tightened. The scrolls are independent of each other, and so the reamer blades may be set slightly tapered at each end, as well as parallel. The blades have a lead at both ends. The tool shown in Fig. 2 can be set to any diameter from 9 to 12 inches, and is mounted on a 3-inch bar. An average of one hour is required for boring and reaming a cylinder 11 inches in diameter and 32 inches long with this bore-reamer.

GENERAL ELECTRIC CENTRIFUGAL AIR COMPRESSORS

Single-stage centrifugal air compressors for which a strong construction, accessibility, improved pressure characteristics, and higher efficiencies are claimed, has been placed on the market by the General Electric Co., Schenectady, N. Y. The compressors are of two types, single- and double-inlet. The single inlet type is designed for the more general use, whereas the double-inlet type is only necessary when the ratio of the impeller inlet and the exit diameter necessitates a double inlet in order to function properly.

The machines are available in sizes having capacities of from 500 to 75,000 cubic feet per minute at a pressure of from 0.75 to 6 pounds per square inch. They are provided with oil pumps designed to furnish plenty of oil to the bearings, and there are no holes in the bearing linings

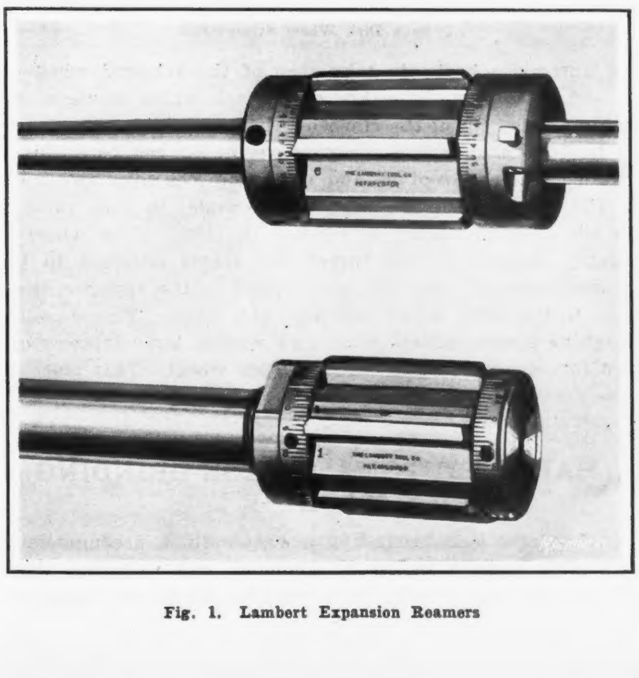


Fig. 1. Lambert Expansion Reamers

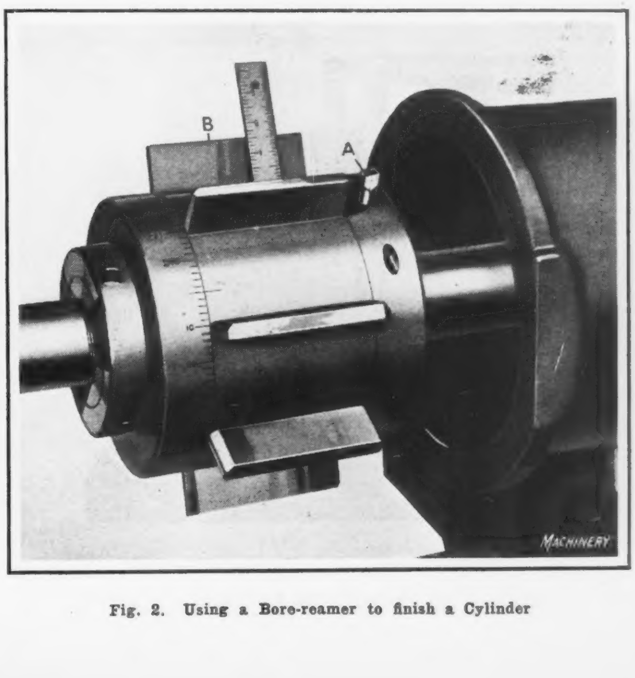
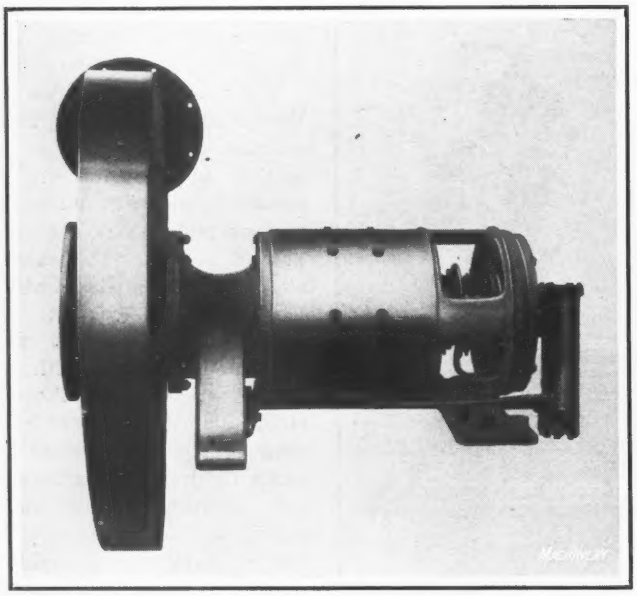


Fig. 2. Using a Bore-reamer to finish a Cylinder



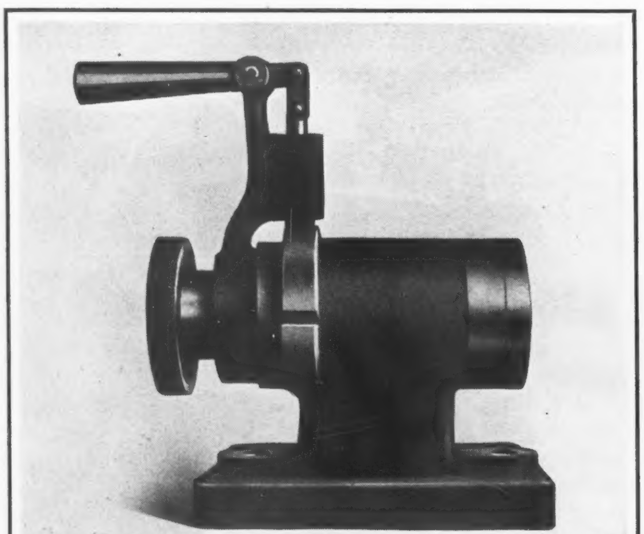
General Electric Motor-driven Centrifugal Air Compressor

which might permit the entry of dust into the lubricating system. A heavy hinged cast-iron cover on one side of the middle bearing bracket may be lifted to inspect the return flow of oil from the lubricating system. The pulsation point of these compressors occurs at very light loads, and the no-load power consumption is only between 60 and 70 per cent of that required for compressors of previous designs built by the company.

BEMIS MILLING FIXTURE

A fixture for holding round stock during slabbing and other milling operations is being made by the E. W. Bemis Machine Co., Worcester, Mass. As will be seen from the illustration, this fixture consists of a cast-iron body in which is fitted a spindle that is threaded to receive collets from 1/8 to 7/8 inch in diameter. The collets are closed by turning the knurled handwheel which draws them back into a hardened ring.

The handle is manipulated to cause a spring pin to lock the spindle in different positions, the support for the handle being fastened to the spindle by means of a set-screw and key. Notches are provided in the body into which the spring pin is located for locking the spindle either in the horizontal or perpendicular position. The spring pin is lifted out of the notches by simply pressing down on the handle.

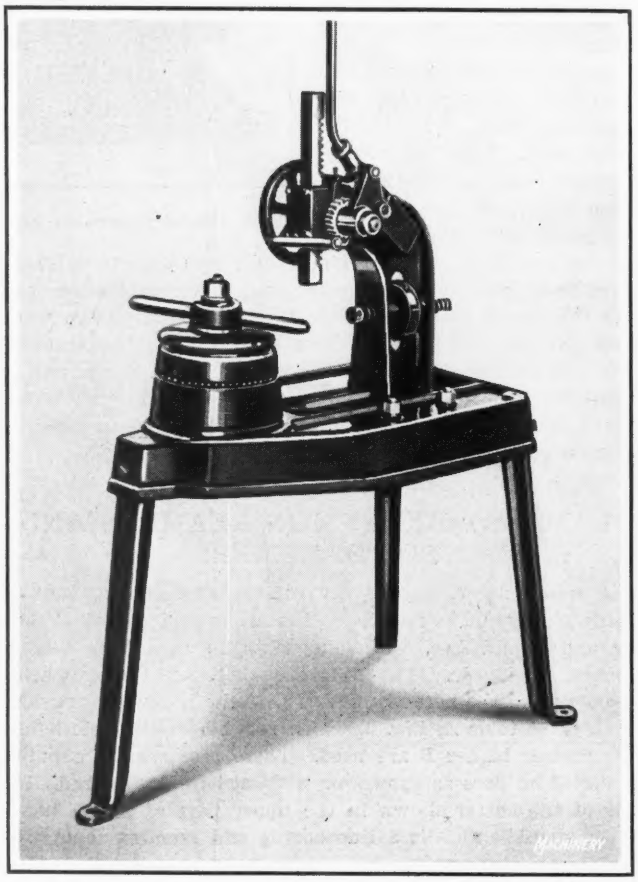


Bemis Milling Fixture

PROSSEN DISK WHEEL STRAIGHTENER

A machine for straightening automobile disk wheels, which is known as the "Prossen," is being placed on the market by the Nilson-Miller Corporation, Hoboken, N. J. This machine consists of a base which supports a turret for holding the wheel, and a frame with the necessary mechanisms for applying the straightening forces. The turret has a heavy central stud which guides a flanged sleeve corresponding to the hub of the wheel. The end of this sleeve is threaded to receive a large wing-nut, by means of which the free flange is forced against the web or central portion of the wheel, thus holding the wheel in the same manner as the regular hub would, but without bolts. The edge of the lower flange is supported by a large-diameter ball bearing so that the wheel can be easily revolved but still is rigidly supported.

The frame has a vertical ram which is operated somewhat like the rack of an arbor press, but is provided with



Prossen Disk Wheel Straightener

an automatic brake to take care of the rebound when released. There is also a horizontal jack which is useful for taking kinks out of the rim when it is damaged. The frame is held by a clamping arrangement under the base, but it can be freely moved in and out after loosening two nuts.

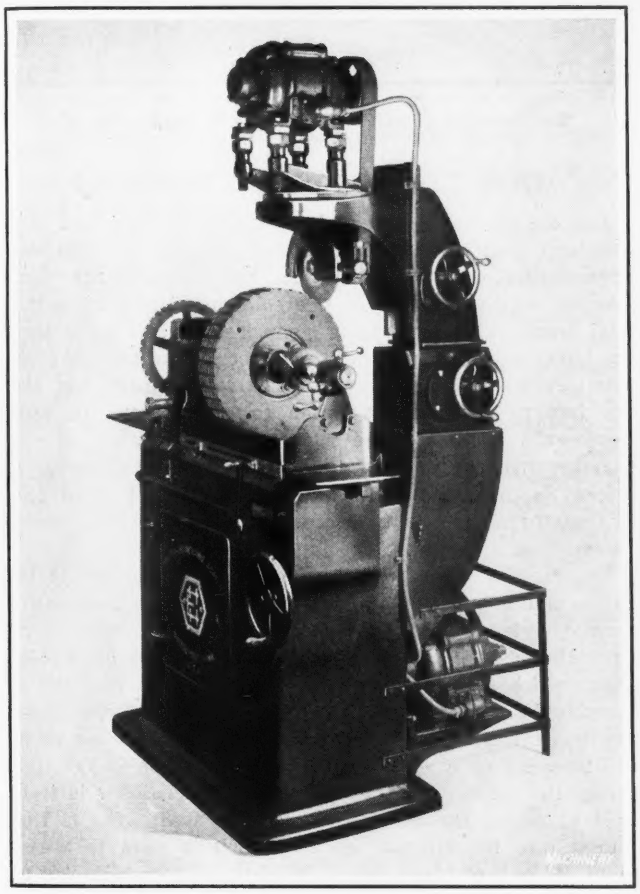
The operation of the machine is simple; in most cases it is not even necessary to remove the tire. The wheel is simply clamped in the turret, the frame adjusted to the proper diameter, and the ram applied in the opposite direction to the force which distorted the wheel. The standard machine accommodates most disk wheels, but adapter rings are furnished to fit any kind of disk wheel. This machine was designed by L. P. Prossen.

HARRIS AUTOMATIC HOB-GRINDING MACHINE

An automatic hob-grinding machine which accommodates a 48-flute hob 16 inches in diameter and weighing about 280 pounds has recently been built by the Harris Engineer-

ing Co., Bridgeport, Conn. This hob is believed to be the largest ever made. The hob-spindle is provided with three sets of large-sized, heavy-duty, Hess-Bright annular ball bearings, and the tailstock is furnished with a taper support carried on a large heavy-duty ball bearing. The indexing mechanism throughout is also equipped with ball bearings, and because of this construction, indexing of the large hob is accomplished almost instantly. The time required to grind a flute in the large hob is no longer than that necessary to grind a flute in a 5-inch diameter hob on the smaller machines built by the company.

Arrangement is made for adjusting the hob to the grinding wheel in a rotary motion so that the proper angular plane of the tooth faces is preserved. The wheel-head is provided with a diamond truing device so that the wheel may always be dressed to the same angle and position. The wheel-head is driven by a separate motor through a large open belt, and means are provided for adjusting the motor

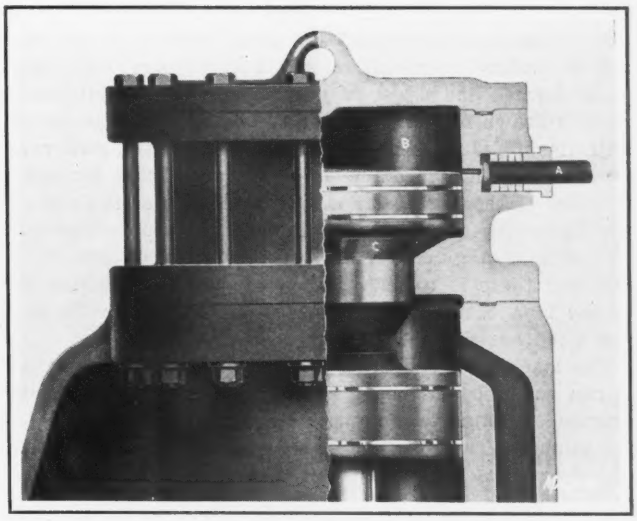


Harris Hob-grinding Machine for Hobs of Unusual Size

brackets to take up as much as 6 inches of slack in the belt. The motor for the indexing and table-reversing mechanism is mounted on the back of the machine, and drives through reduction gearing. The work-table may be moved far enough to one side to permit lifting hobs on or off the machine by means of a hoist without interfering with the motor swivel-head, diamond truing device, or other overhead parts of the machine. The range of this No. 160 machine is for hobs from 6 to 16 inches in diameter. It may be arranged for wet grinding.

CHAMBERSBURG SAFETY CYLINDER COVER

To insure safety from hammer rod accidents on steam drop-hammers, the Chambersburg Engineering Co., Chambersburg, Pa., now makes a safety cover that is applicable to hammer cylinders of all makes. The design is a simple one, free from springs or rods, and is automatic in opera-



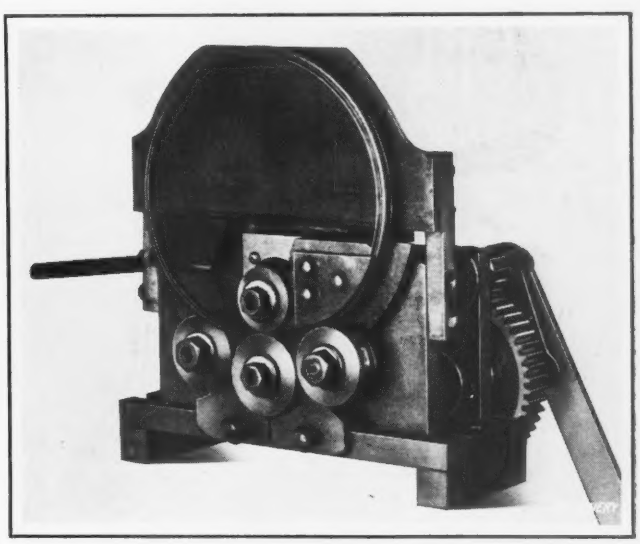
Chambersburg Safety Cylinder Cover for Steam Drop-hammers

tion. The safety cover is mounted on top of the hammer cylinder, as shown. Live steam from pipe *A* is trapped in the closed chamber *B* above the seated plunger *C*, this plunger forming a steam-tight fit in the chamber. In the event of the rod breaking or loosening from the ram, the piston lifts the plunger and is stopped by the compression of the steam trapped above the plunger. As the rod falls, the plunger seats itself and is again ready for protective service. The cover is now standard on Chambersburg steam drop-hammers.

WALLACE RING-BENDING FIXTURE

For bending rings out of solid metals, small tubing, channel irons, or special sections, the Wallace Supplies Mfg. Co., 1312 Diversey Parkway, Chicago, Ill., has designed the machine here illustrated. The ring as shown is in the position occupied when finished. It was made out of a solid bar of extruded brass, of special section used in the manufacture of automobile head-lights, the total cross-sectional area of the bar being approximately equivalent to that of a solid ½-inch square bar. The diameter of the ring is 10 inches, but larger and smaller rings can be made on the same machine. It will be seen, by referring to the illustration, that the ring is entirely circular without any straightness at the ends.

The material is fed into the machine from left to right, the front end being firmly gripped between two centrally located rollers which are actuated by an eccentric lever on the back of the machine. At the bottom of the machine are



Wallace Ring-bending Fixture for a Variety of Stock

two adjustable shoes which extend upward between the first and second and the second and third rollers. These shoes are accurately machined to suit the contour of the stock to be formed and assist in guiding and forming the metal as it is drawn forward between the rolls. There is a slight adjustment for the shoes to take care of any small variations desired in the diameter of the ring being formed or to allow for spring of the metal. The shoe at the right of the upper central roller is also machined to fit the stock and acts as a guide for it. At the left-hand side of the machine there is a deflecting plate which causes the end of the ring that was first formed to clear the rolls as it again reaches them.

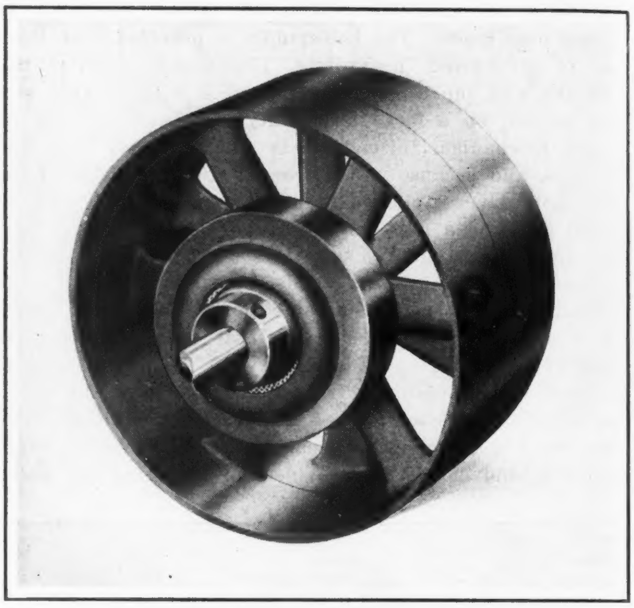
The machine is shown as a hand-operated equipment, but it can easily be arranged with a belt drive. When hand-operated, bending is done at a speed of about 10 to 15 feet per minute. The rolls can also be made to form flat strips of light-gage metal into U, Z, S, and similar shapes, as well as into a ring. The parts produced are suitable for finishing off the rims or edges of various articles such as loud-speaker horns and lamp rings.

BUFFALO FORGES WITH ONE-PIECE STEEL HEARTHS

Standardization of a one-piece 24-inch hearth made of No. 14-gage pressed metal, has been adopted by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y., for the line of rivet forges and hand and power blowers designated as Nos. 222, 212, 312, 512, 522, 712, 722, and 062. This one-piece hearth takes the place of the common cast-iron construction and the built-up steel hearth. One of the forges, equipped with the one-piece steel hearth, is shown in the accompanying illustration.

The fact that the hearth is made in one piece, it is claimed, insures the elimination of rust, because there are no seams in which water can accumulate. The gage of the metal gives the minimum weight consistent with durable construction, and by using pressed metal, the chances of breakage are decreased. The adoption of a 24-inch hearth for all models mentioned gives an increased hearth area that allows for handling larger work. Other characteristic features of the forges remain unchanged; for instance, the forges in the Nos. 200, 300, and 500 series are equipped with New Departure bearings in the blower heads to insure an easy running equipment. In the No. 700 line, plain reamed bearings are furnished.

Buffalo Forge equipped with One-piece Steel Hearth



Gast Loose Pulley Bushing which operates independently of Centrifugal Force

GAST LOOSE PULLEY BUSHING

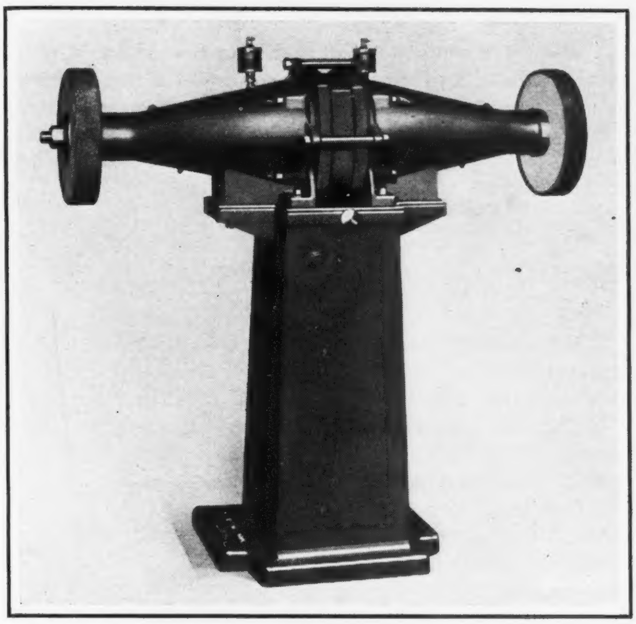
For the efficient oiling of loose pulleys, idlers, and other members that rotate on stationary shafts, the Standard Pressed Steel Co., Jenkintown, Pa., has developed the "Gast" bushing which functions entirely independently of centrifugal force. This bushing is comprised of two main parts, the bushing proper and an oil chamber. The two parts are interlocked so that they cannot be taken apart, but they are free to revolve in relation to each other. In other words, the bushing turns with the pulley, while the oil chamber remains stationary, and consequently whatever lubricant is contained in the oil chamber is not acted upon by centrifugal force, but remains still. This device is shown mounted on a pulley in the illustration.

The bushing extends within the oil chamber to its full width and forms a neck in which there is a rectangular opening extending about one-third of the way around the circumference. From this neck is suspended an endless chain which dips into the oil. It will be seen that the oil chamber has a hub and a circular opening in front. After the device has been pressed into the hub of a loose pulley and mounted on a shaft in the proper relation to the tight pulley, the set-screw in the hub of the oil chamber is tightened to fasten the oil chamber to the shaft. Oil is then poured into the circular opening until it rises to within about 1/8 inch of the point of overflow, after which the device is ready for use.

When the loose pulley revolves, the chain suspended from the neck within the oil chamber conveys a steady stream of oil, part of which is deposited on the stationary shaft through the rectangular opening. The oil finds its way between the shaft and the bore of the bushing where it is wanted. Oil is delivered once every revolution, and so the lubrication is directly proportional to the need. After the oil is passed through the bushing, it is returned to the oil chamber. One filling lasts for a long period, but it is desirable to replenish the oil once every three months or so. As the hub of the oil chamber takes the end thrust of the bushing, no extra set-collar is required.

C. A. W. POLISHING MACHINE

A polishing machine designed for driving the wheel-spindle at 3600 revolutions per minute has recently been introduced on the market by the Cleveland Armature Works, 4732 St. Clair Ave., Cleveland, Ohio. This speed and 1800 revolutions per minute are the only speeds at which an alternating-current motor of sixty-cycle frequency can run.



C. A. W. Heavy-duty High-speed Polishing Machine

The machine is made in four sizes which are equipped with a 5-, 7½-, 10-, and 15-horsepower motor, respectively. Each size is normally furnished with either 12- or 14-inch polishing wheels. The spindle runs through the rotor so that wheels may be mounted at each end. With a 14-inch wheel, the peripheral speed is about 13,000 feet per minute. At the front of the machine there is a knob used to operate a make-and-break oil switch in starting and stopping the machine.

In working out the design of this machine, special attention was given to the selection of bearings and to the design of bearing mountings so that the machine would operate satisfactorily under the high speed for which it is intended. Two end plates carry the stator laminations and these plates are held together by four steel tie-rods over which the laminations are assembled. The plates are clamped in place and then welded to the rods. The tie-rods serve the double purpose of holding the two plates together and of compressing the laminations as the rods cool after welding. Four Timken roller bearings support the spindle —two located at each end. Each pair of bearings is held in a steel sleeve contained in a bell-shaped casting, which is held to the plates by means of four cap-screws. This construction is further strengthened by three tie-rods which fit through lugs on the bell castings. A rigid construction is essential because the strain of an out-of-balance body on its carrying shaft and supports increases with the square of the speed, and it is difficult, if not impossible, to secure dynamic balance of polishing wheels.

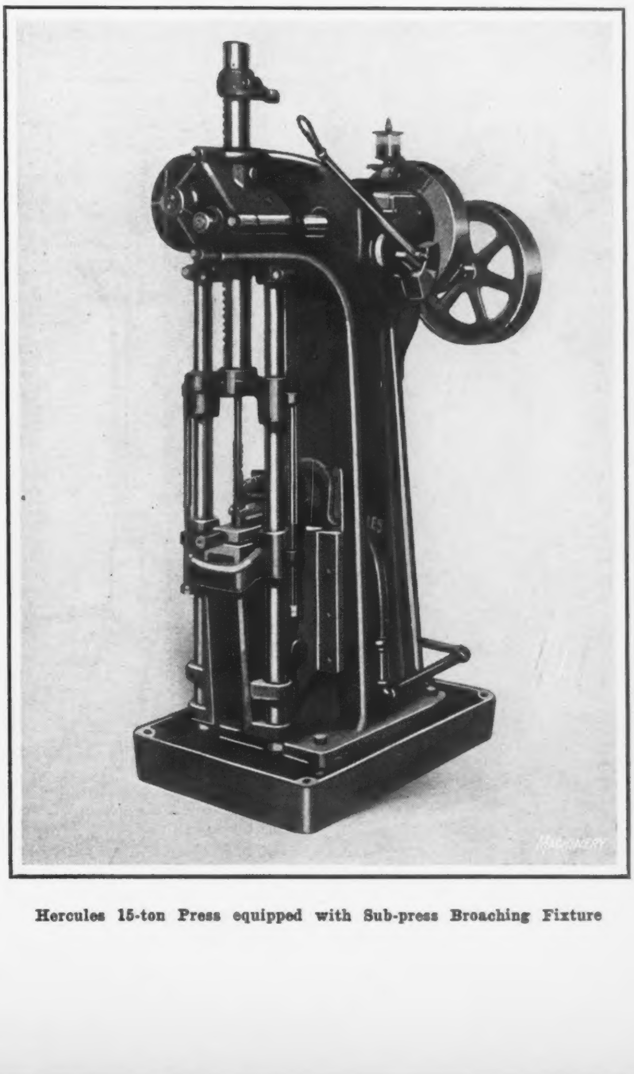
Adequate lubrication is assured by a novel means, the roller bearings being made to serve the additional function of centrifugal pumps for circulating oil. Each pair of roller bearings is mounted with the tapers opposed to each other and with the larger ends toward the outside. The bell castings serve as reservoirs in which oil is kept at such a level that the bottom of each bearing dips into it. As each bearing rotates, it picks up oil, and centrifugal force causes this oil to run to the larger end of the bearing from which it is thrown against a deflector plate. The oil then drops into a channel through which it returns to the reservoir. In this way a constant circulation of oil is maintained.

The high speed at which the machine is driven makes it desirable to have a heavy column, so as to obtain a solid foundation. Another condition that must be provided for is the fact that different customers are likely to specify various heights from the floor to the spindle. Both these conditions are met by the use of concrete in the following way: Two iron castings are used at the top and bottom of the column, and these castings have cored holes in which steel reinforcing rods are a free fit. On the upper side of the lower casting and the lower side of the upper casting there is an annular groove which receives a sheet-metal form that constitutes the outside of the column. With this form in place, the tie-rods are electrically welded in the castings, after which concrete is poured into the form. Further reinforcement of the concrete is obtained by webs welded to the inside of the sheet-metal form and by the use of wires around the reinforcing rods. The sheet-metal form is painted to obtain a desirable finish.

HERCULES SUB-PRESS BROACHING FIXTURE

For use in conjunction with its 15-ton broaching press, the Hercules Mfg. Co., 446 E. Woodbridge St., Detroit, Mich., has brought out the sub-press broaching fixture shown on the machine in the accompanying illustration. By the use of this sub-press it is possible to correct a rough-drilled hole so that it is smooth, straight, concentric, and at right angles with a certain face. The illustration shows the sub-press set to correct the rough-drilled hole in the small end of automobile connecting-rods. After this step the large end of the rod is finished in the same way, producing an accurate rod without a straightening operation. It is said that the increase in production is 20 to 1 over the former method used and that the work is more uniform.

The work is held in the correct position by means of a suitable fixture, and the pilot end of the broach is passed into a bushing in the lower guide. When power is applied, the upper guide, which carries a bushing to fit the shank of the broach, moves downward and carries the broach through the work, the tool thus being guided at both ends. In this way the hole is corrected according to the surface on which the work is held in place. After the broach has passed through the part, the power feed is automatically disengaged. On the return of the ram, the lower guide is lifted back to the loading position by means of check-nuts on the feed-rods.



Hercules 15-ton Press equipped with Sub-press Broaching Fixture

Fig. 1. "MetaLayeR" used in the Schoop Process of spraying Metals

"METALAYER" AND MASS COATING MACHINE

For use in connection with the Schoop process of spraying metals, the Metals Coating Co. of America, 495-497 N. 3rd St., Philadelphia, Pa., has brought out the improved "MetaLayeR" shown in Fig. 1. With th› muzzle design of this pistol the molten and atomized metals are under such good control that practically no oxide appears in deposited coatings. By means of this process practically any commercial metal can be coated on any substance.

In Fig. 2 is shown a machine developed for spraying in bulk articles weighing from a fraction of an ounce up to 10 pounds. Quantities of 100 pounds at a time may be coated in from eight to thirty minutes. Threaded parts do not require rethreading after the spraying and internal surfaces are reached by the coating. The machine is equipped with preheating coils, a tumbling barrel, and upper and lower trays. Parts may be polished or tumbled before removal.

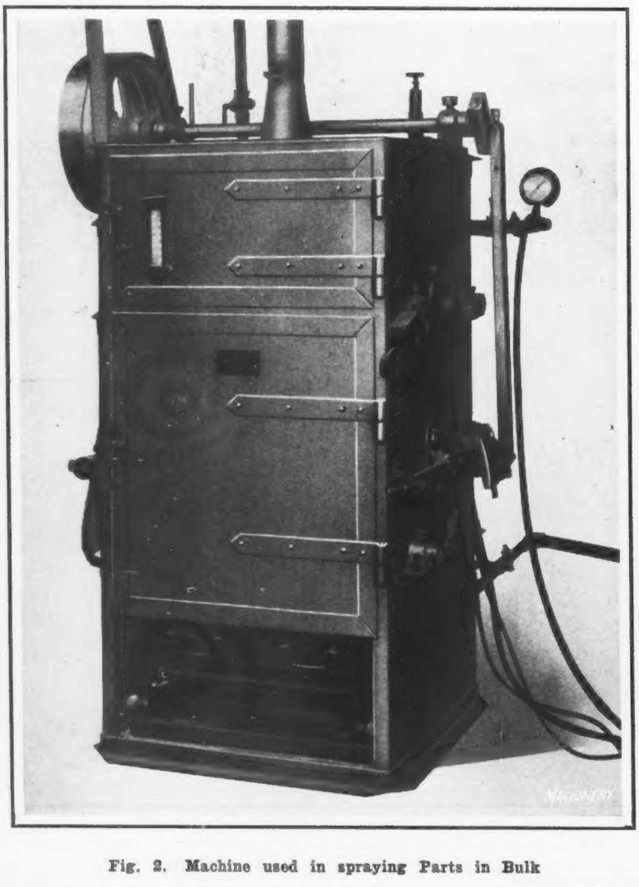


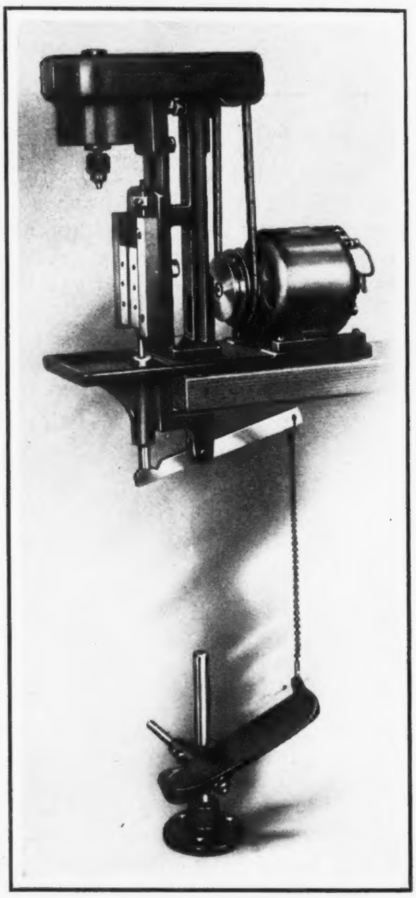
Fig. 2. Machine used in spraying Parts in Bulk

HELLER RUBBER CUSHION HAMMER

A line of machinists' ball-peen hammers with a rubber cushion extending through the hole in which the handle fits is now manufactured by the Heller Bros. Co., 865 Mount Prospect Ave., Newark, N. J. The purpose of the cushion is to absorb the shocks produced in using the hammer. A nail hammer is also made in a similar design.

BICKNELL-THOMAS VERTICAL TAPPING MACHINE

A high-speed vertical tapping machine equipped with an individual motor drive has recently been added to the line of equipment manufactured by the Bicknell-Thomas Co., Greenfield, Mass. This No. 11-M machine has a tapping capacity of 1/4 inch in cast iron or brass, and 3/16 inch in steel. The motor is of 1/6 horsepower capacity, and can be furnished for either direct or alternating current. It is provided with a cord and attachment plug to fit any lamp socket. There are ordinarily two tapping speeds of 600 and 1000 revolutions per minute, but when the machine is intended for tapping brass, speeds of 1400 and 2000 revolutions a minute can be provided. In the driving mechanism is incorporated a hardened alloy-steel cone clutch, which is mounted on the chuck spindle. When the tap is entered to the required depth, the spindle automatically reverses at twice the entering speed. The drive is so sensitive as to prevent the breaking of even the smallest taps.

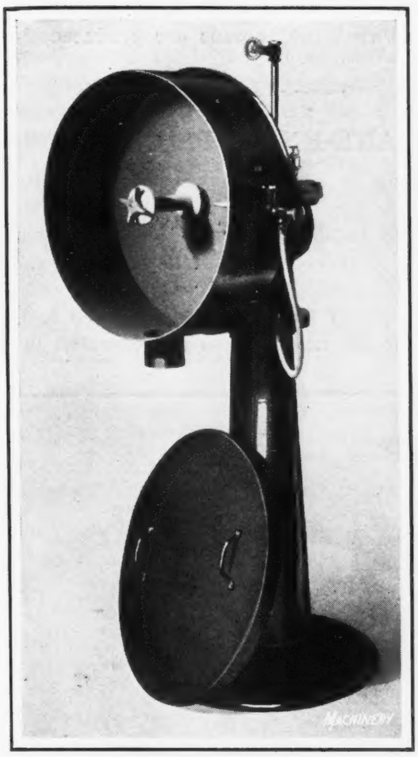


Bicknell-Thomas Vertical Tapping Machine

The vertical table is hardened and surface-ground and slides on steel balls. It has a T-slot and six tapped holes for locating and fastening work-holding fixtures. The table is similar to that used on the No. 1 horizontal tapping machine, and so the same fixtures may be used on either machine. The table is operated by the lever and foot-treadle, which leaves both hands of the operator free to handle work. All moving parts, including the belt, are guarded to prevent injury to the operator. The driving head is packed with grease and it automatically lubricates all parts. The weight of this machine is approximately 70 pounds, and the bench space occupied 8 by 14 inches.

KOPF POLISHING-WHEEL CLEANING MACHINE

Worn abrasive is commonly removed from cloth and felt polishing wheels by turning it off on the polishing lathe with either a steel tool or a broken grinding wheel. This method removes a considerable amount of cloth or felt each



Kopf Machine for cleaning Polishing Wheels

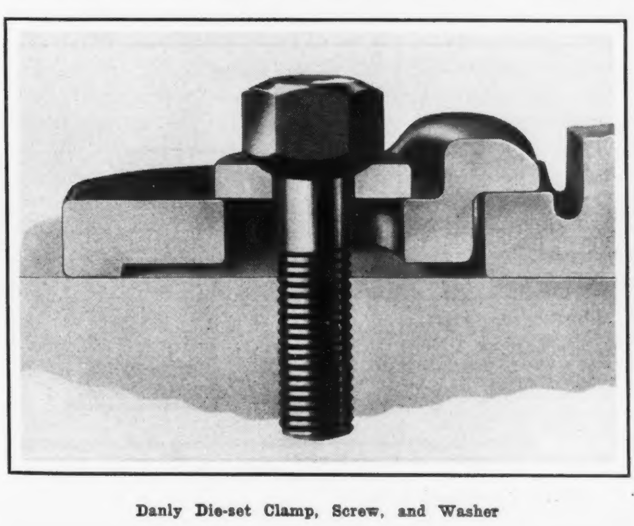
time the wheel is cleaned till the diameter has been reduced to the point where the wheel becomes useless. In addition, from thirty to ninety minutes a day per polisher is usually spent in cleaning wheels. To permit this operation to be performed more efficiently and quickly, M. G. Kopf, 612 Schwind Bldg., Dayton, Ohio, has developed the outfit here illustrated.

A cylinder provided with an easily removable cover is mounted on the usual polishing lathe, and a nozzle that is connected to a steam line enters this cylinder at one side. The wheel to be cleaned is placed on the spindle and locked in place by means of a wing-nut which provides for quick handling. The steam nozzle is then adjusted to within ½ inch of the wheel face, and locked by a screw. After power is applied and the wheel attains a speed of about 2200 revolutions per minute, the steam is turned on.

Owing to the moisture of the condensed steam and the heat imparted, the glue and abrasive become loosened, and are thrown off, together with any oil, by the centrifugal action. The water and abrasive mixture passes out through the drain at the bottom of the cylinder either directly to a sewerage system or to a trap from which the abrasive may be reclaimed. For leather-faced block, walrus-hide, and sheepskin wheels, water is admitted with the steam through a connection above the steam valve. The machine is adapted to cleaning wheels up to 20 inches in diameter and up to 4 inches in face width. It takes only about two minutes to clean a wheel by this method, and the operation is far more sanitary because of the elimination of flying dust.

DANLY DIE-SET CLAMPS

Standard clamps, screws, and washers designed primarily to meet the needs of punch press departments are now manufactured by the Danly Machine Specialties, Inc., 4907 Lincoln Ave., Chicago, Ill. The clamps are heavy carbon-steel forgings of such design that the clamping screw is brought close to the object to be held and is offset sufficiently to allow ample clearance of stock over the head of the cap-screw. The screws are swivel-headed and provided with U. S. standard nut-size heads. The heads are hardened to withstand rough wrench usage.

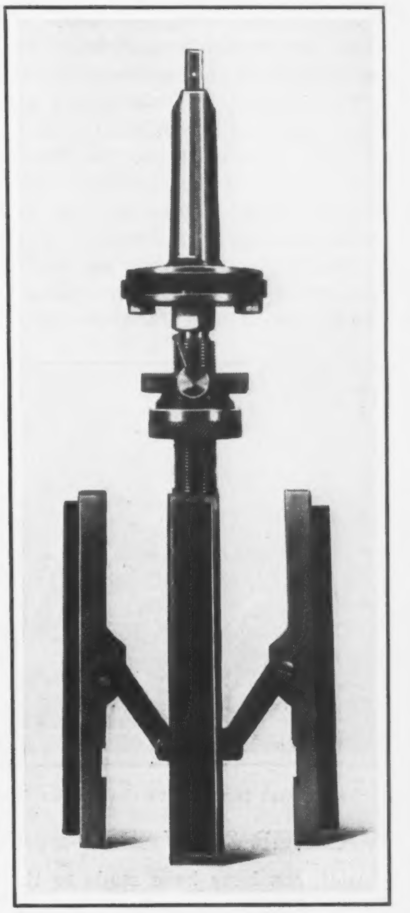


Danly Die-set Clamp, Screw, and Washer

The washers are made of steel and are extra heavy. They have a ball seat to suit the head of the cap-screw. The diameter is sufficient to span die-shoe slots, and the washer is strong enough so as not to "dish" under heavy strains. The screw and washer are used on the slotted-ear types of die sets, whereas other types of die-shoes with a clamping surface use a clamp, screw, and washer.

CAMPBELL CYLINDER HONE

A cylinder hone for burnishing the bores of internal-combustion engine cylinders after they have been rebored or reground, and for refinishing cylinders that have been slightly scored but not worn out of round or taper, is manufactured by the Campbell Auto Works, 232-240 N. El Dorado St., Stockton, Cal. Cylinder bores that are out of round or tapered should be rebored before being honed, as the hone is only intended to smooth them up.

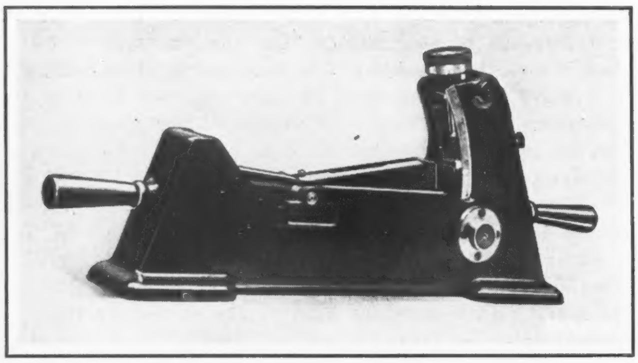


Campbell Cylinder Hone

This hone has a range of from 2¾ to 5 inches in diameter, the illustration showing the tool expanded. The adjustment of the stones is effected by means of the knurled collar under the driving spindle. Only one spring controls the four expanding arms, and a change in the diameter of the stones in no way affects the tension of the spring, which remains the same at all times. This is the principal feature claimed for the hone. The stones are 6 inches by ⅝ inch by ⅜ inch, and set in aluminum holders. The tool can be used in a drilling machine or a portable electric drill.

PRECISION MACHINE LEVEL

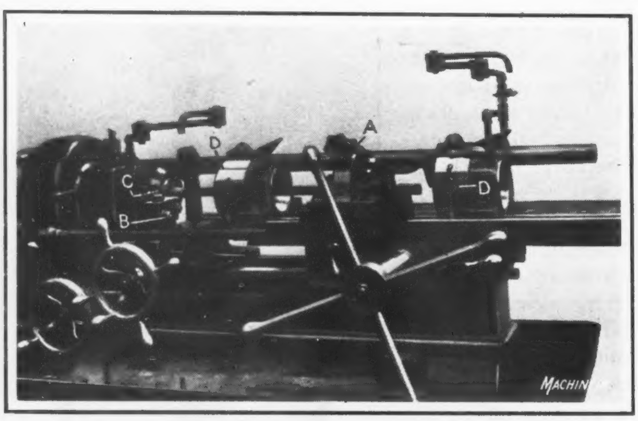
A precision machine level of 30 degrees range has been placed on the market by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, for whom the R. Y. Ferner Co., 1410 H St., N.W., Washington, D. C., is the American agent. This instrument consists of a heavy cast-iron base in which is pivoted a graduated level vial. Tilting of the vial in the vertical plane is accomplished by turning a worm, which engages an accurate sector rack that has teeth spaced at half-degree intervals. The position of the vial at any point is read on a sector scale, graduated to half degrees, and on the micrometer head of the worm-shaft, graduated to 10 seconds.



Precision Machine Level marketed by the R. Y. Ferner Co.

The instrument is so adjusted that when the base is horizontal and the bubble of the level is between the central graduations on the vial, the indexes on the graduated sector and on the micrometer head both read zero. Accordingly, when placed on a tilted surface, the angle of the level with the horizontal plane can be measured by turning the micrometer head until the bubble of the vial again rests between the central graduations. The level vial is said to be sensitive to within six seconds of arc per division.

The base of the instrument measures about 3¼ by 17 inches and has four machined bearing surfaces. The weight is approximately 20 pounds. Handles are provided at each end for convenience in lifting and carrying the apparatus. Because of its accuracy and the possibility of measuring the actual amount that a surface is out of level, this machine is adapted for use in setting machine beds level, measuring the tilt of work-tables in setting them for angular work, and in measuring the angle to which work has been finished.



Equipment furnished on the Warner & Swasey Staybolt Machine

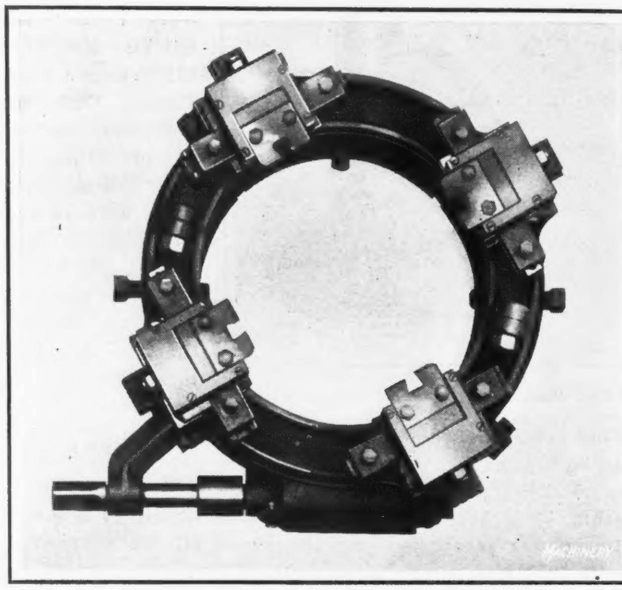
WARNER & SWASEY STAYBOLT MACHINE

Additions have been made to the equipment supplied on the staybolt machine built by the Warner & Swasey Co., Cleveland, Ohio. The machine, as equipped at present, will turn and face the tail end of the staybolt before the threading operation, and thereby relieves the chasers of the necessity of cutting through the rough scale. Not only does this insure longer life to the chasers, but it considerably speeds up the threading operation. This attachment is shown at *A*.

The forming tool *B* on the cross-slide likewise prepares the head for the thread-cutting. At this location there is also a cutting-off tool held in the swinging holder *C*. The threading operations are performed by the two die-heads *D* mounted on the turret slide. These are so adjusted that the threads are produced in a continuous lead.

BEAVER SQUARE-END PIPE CUTTERS

Three new large sizes of Beaver square-end pipe cutters are being introduced to the trade by the Borden Co., Warren, Ohio. These sizes handle pipe from 2½ to 6 inches, 4½ to 8 inches, and 9 to 12 inches, respectively. The same knife construction and automatic feed as is incorporated in the smaller sizes built by this company, are used in the large sized cutters, but the new designs are operated by a

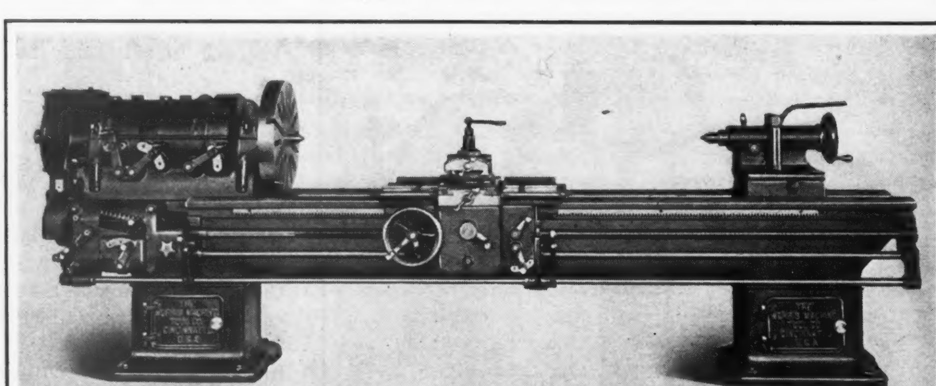


Beaver Large-sized Square-end Pipe Cutter

ratchet handle which is applied to a driving pinion. This pinion rotates the cutting knives by means of an enclosed worm-gear. In addition to the hand ratchet, power may be used for operating the cutters. The various parts are made of steel and malleable iron, and all sizes are portable.

MORRIS GEARED-HEAD LATHE

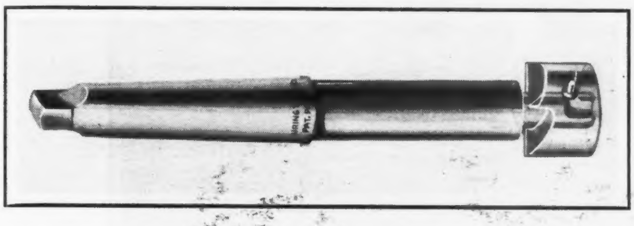
A 22-inch geared-head lathe of improved design has recently been brought out by the Morris Machine Tool Co., Cincinnati, Ohio. This machine is equipped with a single-pulley-driven headstock of the selective-speed type. Twelve spindle speeds are obtained through sliding gears and a positive back-gear clutch. The driving pulley is fully enclosed and provided with a friction clutch and brake which is operated either by a lever at the apron or one at the headstock. This arrangement permits the operator to start



Morris Geared-head Lathe

and stop the machine and apply the brake without leaving his working position. When equipped with a motor drive, the motor should be of 5 horsepower capacity and run at about 1200 revolutions per minute. It is mounted on the headstock, and either a belt, chain, or gear drive can be furnished.

The quick-change mechanism furnishes forty-five changes, the thread range being 2 to 60 threads per inch, and the feed range, 4 to 120 turns per inch. At the front of the bed the carriage travels on a vee, and at the rear, on a flat track. It is gibbed to the bed at both the front and back. The carriage is drilled and tapped to receive a taper attachment. The apron is a one-piece box casting in which all bearings are cast integral and in which the gears and shafts are supported at each end. Both cross- and longitudinal-feed clutches are operated by means of a single lever, an interlocking device preventing the engagement of the thread and feed mechanisms at the same time. The swing over the ways is 23 inches, and over the carriage, 15¼ inches.



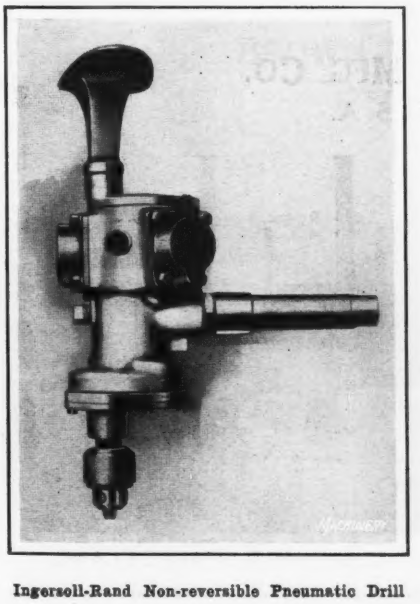
Gairing Driving Pilot for Interchangeable Back Spot-facer Cutters

GAIRING BACK SPOT-FACER DRIVING PILOT

Driving pilots for the interchangeable back spot-facer cutters manufactured by the Gairing Tool Co., Inc., 19 W. Woodbridge Ave., Detroit, Mich., are made from chrome-nickel steel with either straight, taper, or special shanks. The illustration shows a taper-shank pilot complete with the cutter. These pilots are hardened and ground all over and all standard pilots are made under-size from 0.003 to 0.008 inch, depending on the rated diameter, so as to obtain a running fit. There are nine regular sizes which accommodate cutters from ½ to 5 inches in diameter.

INGERSOLL-RAND PNEUMATIC DRILL

A new light-weight non-reversible pneumatic drill known as size D has recently been brought out by the Ingersoll-Rand Co., 11 Broadway, New York City. This tool is intended for drilling holes up to 9/16 inch in diameter and reaming holes up to 5/16 inch. It may be fitted with either a breast-plate, feed-screw or grip handle, which makes it adaptable for a great variety of work. The construction is similar to that of the Nos. 6 and 600 drills built by this company. The case is made of aluminum, with steel bushings cast in all the bearing holes and in the throttle hole. The motor is of a special three-cylinder design with cast-iron cylinders that are renewable and interchangeable. The rotating parts of the motor are balanced so as to eliminate vibration and reduce wear and tear. Some of the specifications of this tool are as follows: Recommended working speed at an air pressure of 90 pounds per square inch, 700 revolutions per minute; length of feed with feed-screw, 2½ inches; length over-all, with breast-plate and chuck, 15 inches; distance from side to center of spindle, 1½ inches; and total weight, including the breast-plate and the chuck, 14 pounds.



Ingersoll-Rand Non-reversible Pneumatic Drill

* * *

THE LEIPZIG MACHINE TOOL EXHIBIT

From MACHINERY'S Special Correspondent

The German machine tool industry was represented in Leipzig by exhibits from about three hundred manufacturers, occupying space amounting to 8000 square meters (nearly two acres), most of the machines being in operation. At the next Fair it is planned to place the machine tool exhibition in a separate building consisting of three galleries, each about 180 meters (590 feet) in length. It will be possible for freight trains to enter the building, and traveling cranes having a lifting capacity of 40 tons will be installed to facilitate the handling of the heavy machinery.

The improvements made by German machine tool manufacturers in their products since the armistice are considerable and deserve attention. Germany is now apparently free from the necessity of obtaining much special machinery from foreign countries, German isolation during the war and the condition of exchange thereafter, having proved powerful incentives to developments, both in copying and inventing new types of machines, and nearly all the various types and models necessary to their industrial requirements will be found in the German markets. At the Leipzig Fair many new models were exhibited, the development being particularly marked in grinding machines and automatic screw machines. A considerable number of manufacturers have engaged in the production of automatic screw machines, and the number of grinding machines has been practically doubled.

The development of the automatic feature in machine tools is due largely to the influence of the Society of German Engineers (Verein Deutscher Ingenieure) in fostering standardization, which greatly helps the development of automatic machinery. We find many copies of American machines in this category, such as the Acme, Gridley, Cleveland, Brown & Sharpe, and others.

Grinding machinery also has made great progress, and we note particularly the Naxos-Union, the Blanchard type, and a planer type driven by three motors. The disk grinding machine is represented by the product of the Diskus Co. A planing machine with a separate grinder and driven hydraulically, is a late model which will easily compete with the highest type planers.

A number of gear-cutting machines were shown. Cutting by the milling process, by planing, and by Fellows cutters, were all shown. The Fellows type of machine is built by Lorenz and by Zimmerman. The latter showed also a model of a multiple high-speed machine, 450 strokes to the minute, which resembles very closely the Fellows machine of the same type. Other machines designed for helicoidal cutting are of interest.

Many German plants that formerly purchased American machines are now buying German tools. The Krupp Works, where 300 Fellows machines are installed, are now buying the Zimmerman machine, which uses exactly the same tools. Many machines for cutting conical and spiral gears were exhibited. Among other machines exhibited was a locomotive wheel lathe built by Hagenschidt. A considerable number of machines in the exhibit were in actual operation, and many were turning out the product for which they were designed.

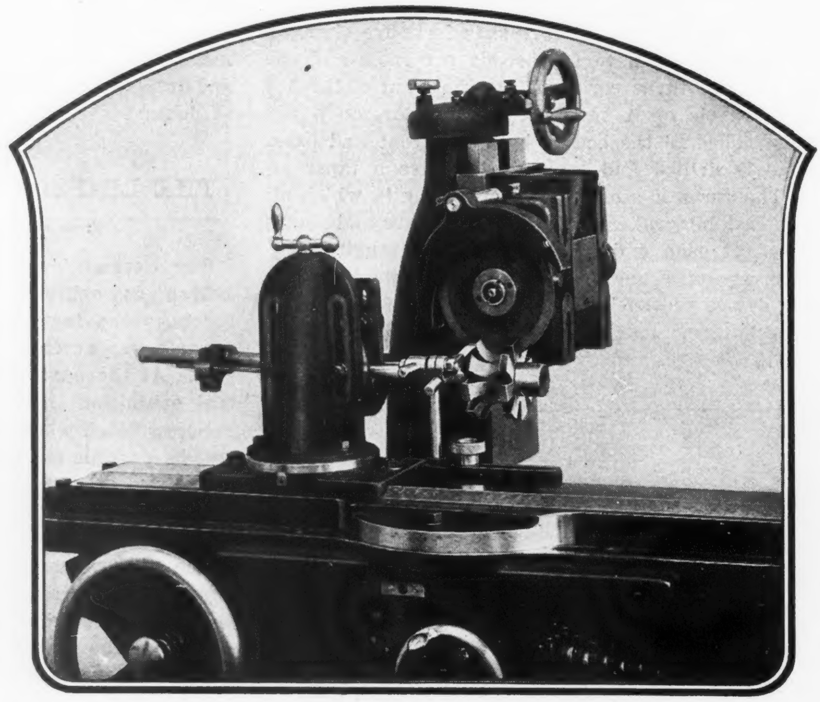
BROWN & SHARPE MACHINES

BS

BROWN & SHARPE PRODUCTS

Milling Machines
Grinding Machines
Gear Cutting Machines
Screw Machines
Machinists' Tools
Cutters and Hobs

WORLD'S STANDARD FOR QUALITY



HANDINESS

Most mechanics can remember with pride some jig or tool of their own making that was well suited to the job at hand. Our task is to design machines and tools suited to a wide variety of work. To make all our products adaptable and handy requires engineering skill of a highly practical nature. Our engineers keep in constant touch with shop requirements. Their daily contact with the shop helps them to secure the simplicity and handiness of design which are the marks of every Brown & Sharpe Product.

A Handy Machine for all kinds of grinding. Brown & Sharpe No. 13 Universal and Tool Grinding Machine

Adaptable—this one word describes the Brown & Sharpe No. 13 Universal and Tool Grinding Machine. This machine grinds cylindrical work, straight or taper, and sharpens reamers, cutters, etc. With the addition of various attachments for surface grinding, internal grinding, hob grinding, and radial grinding, the No. 13 displays an unusual versatility.

To shops which need a single machine capable of grinding a wide variety of work this machine will prove valuable. Plants with a varied assortment of cutters will also welcome the installation of one of these machines. Our general Catalog gives complete specifications of the machine and describes its various attachments. Write today for Catalog No. 137.

BROWN & SHARPE MFG. CO.
Providence, R. I., U. S. A.

There wasn't room on this page to describe all the attachments for the No. 13 Universal and Tool Grinding Machine, but Catalog No. 137 describes four of the principal attachments, and our complete line of machine tools, small tools and cutters in addition. Write for your copy today.

32 Acres of Floor Space—THE BROWN & SHARPE PLANT,

TRADE NOTES

Moltrup Steel Products Co., Beaver Falls, Pa., has moved its Boston office from 201 Devonshire St. to 80 Boylston St.

Century Electric Co., 1827 Pine St., St. Louis, Mo., manufacturer of motors and fans, has changed the location of its Chicago office from 56 W. Randolph St., to 160 N. La Salle St., Rooms 1931-3.

Horsburgh & Scott Co., Cleveland, Ohio, is building a new four-story plant of steel and concrete construction, faced with brick. The new building will give the company three times its former capacity.

Wickman Screw Works, Pittsburg, Pa., manufacturers of screw machine products, have been succeeded by the Union Screw & Mfg. Co. The ownership and active management will be the same as heretofore.

Yost Gearless Motor Co. and the Superior Spring Co. have combined under the name of the Yost Superior Co. The reorganized company will make the Yost gearless motor washer and Superior coiled springs.

William K. Stamets has moved his Cleveland office from 974 Rockefeller Bldg. to more spacious quarters at 774-6 Rockefeller Bldg. This change was necessitated by the increasing amount of business handled by the Cleveland office.

Manning, Maxwell & Moore, Inc., announces that its Cleveland and Cincinnati offices have been consolidated, with headquarters at the Huron-Smith Bldg., Huron Road, Cleveland, Ohio. E. H. Merrick has been appointed district manager.

U. S. Ball Bearing Mfg. Co., 4563 Palmer St., Chicago, Ill., manufacturer of Strom ball bearings, has changed its name to the Strom Ball Bearing Mfg. Co., so the product and company name will hereafter be the same. No changes have been made in the personnel.

Ruggles-Klingemann Mfg. Co., 200 Devonshire St., Boston, Mass., was recently appointed exclusive New England representative of the Uehling Instrument Co., Paterson, N. J., manufacturer of carbon dioxide recorders and indicators and other power plant instruments.

Ferro Machine & Foundry Co. has just completed the third factory addition to its plant in Cleveland, Ohio. This firm makes gray iron castings for the automobile trade, and it is believed that the new building will make possible greater efficiency and a larger product.

Pratt & Whitney Co. announces that on and after May 1 its stock of small tools and gages will be carried at the main office of the company in the Trinity Bldg., 111 Broadway, New York City, instead of at the warehouse, 326 Hudson St. Therefore, all orders and mail should be sent to 111 Broadway.

John Steptoe Co., Cincinnati, Ohio, has recently acquired the manufacturing and selling rights of the portable electric tools formerly built by the Automatic Electrical Tool Co. of Cincinnati. The full line comprises portable electric screwdrivers, electric drills, electric lag-screw drivers, bolt and nut tighteners, etc.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., is making several additions to its plant in Sharon, Pa. The new buildings, which will be fireproof and of reinforced concrete and steel, will afford an additional floor space of about six acres, and will be devoted chiefly to the manufacture of transformers with a capacity greater than 500 kilovolt ammeters.

Richey-Rhynearson Machinery Co. is a new machinery house incorporated by Granville A. Richey, B. H. Rhynearson, and Fred Schellenberg, formerly of the Vonnegut Machinery Co., Indianapolis, Ind. The company will be located in a three-story building at 23-25 E. South St., Indianapolis, and will engage in the selling of new and rebuilt machine tools and electrical equipment.

Galt Machine & Screw Co., Ltd., Galt, Ontario, Canada, has taken over and will operate, on a much larger scale, the business formerly carried on by the Galt Machine Screw Co., Ltd. Considerable new equipment will be added from time to time. The officers of the new company are R. W. Roelofson, president; C. E. A. Dowler, vice-president; and C. K. Jansen, secretary-treasurer.

Motorbloc Corporation, Summerdale, Philadelphia, Pa., has recently added four new sizes to its line of motor-driven chain hoists, namely 1/8, 3/8, 3/4, and 1 1/2 tons. The line now ranges from 1/8 to 10 tons. The company has just taken on additional space, where it will do its own assembling and testing, and a testing tower is being installed to give each hoist a thorough running test with a 50 per cent overload.

Seifreat-Woodruff Co., Dayton, Ohio, has been succeeded by the Seifreat-Elstad Machinery Co. William N. Woodruff, formerly vice-president and treasurer of the company, has retired, and his interest has been purchased by Ernst C. Elstad. The company will continue to carry in stock in its Dayton store-room a complete line of machine tools and machine shop equipment, such as arbor presses, chucks, and electrical tools.

Muzzy-Lyon Co. and the Federal Bearing & Bushing Corporation, both of Detroit, Mich., have been merged into one organization which will be known as the Federal-Mogul Corporation. The Muzzy-Lyon Co. has produced babbitt metals for over twenty-five years, and during the last fifteen years has also produced bronze-back babbitt-lined and die-cast bearings and bushings. The Federal Bearing & Bushing Corporation has specialized in bronze.

Marlin-Rockwell Corporation, 402 Chandler St., Jamestown, N. Y., has taken over the business, trade name, and good will of the Gurney Ball Bearing Co. The management, policy, and product of the Gurney Ball Bearing Co. will be continued along the same lines as heretofore and the sales representatives will remain the same in each district. The business will be carried on under the name of the Marlin-Rockwell Corporation, Successor to Gurney Ball Bearing Co.

Smith-Heylandt Co. has been recently organized to take over the patents, importation, sale, and distribution of the Heylandt apparatus for the manufacture of oxygen and other gases by the liquefaction process. In addition to liquefaction apparatus, liquid oxygen breathing equipment will also be manufactured. Elmer H. Smith heads the new organization as president, and John R. R. Miles will be secretary. The company will be located at 2633 Fourth St., S. E., Minneapolis, Minn.

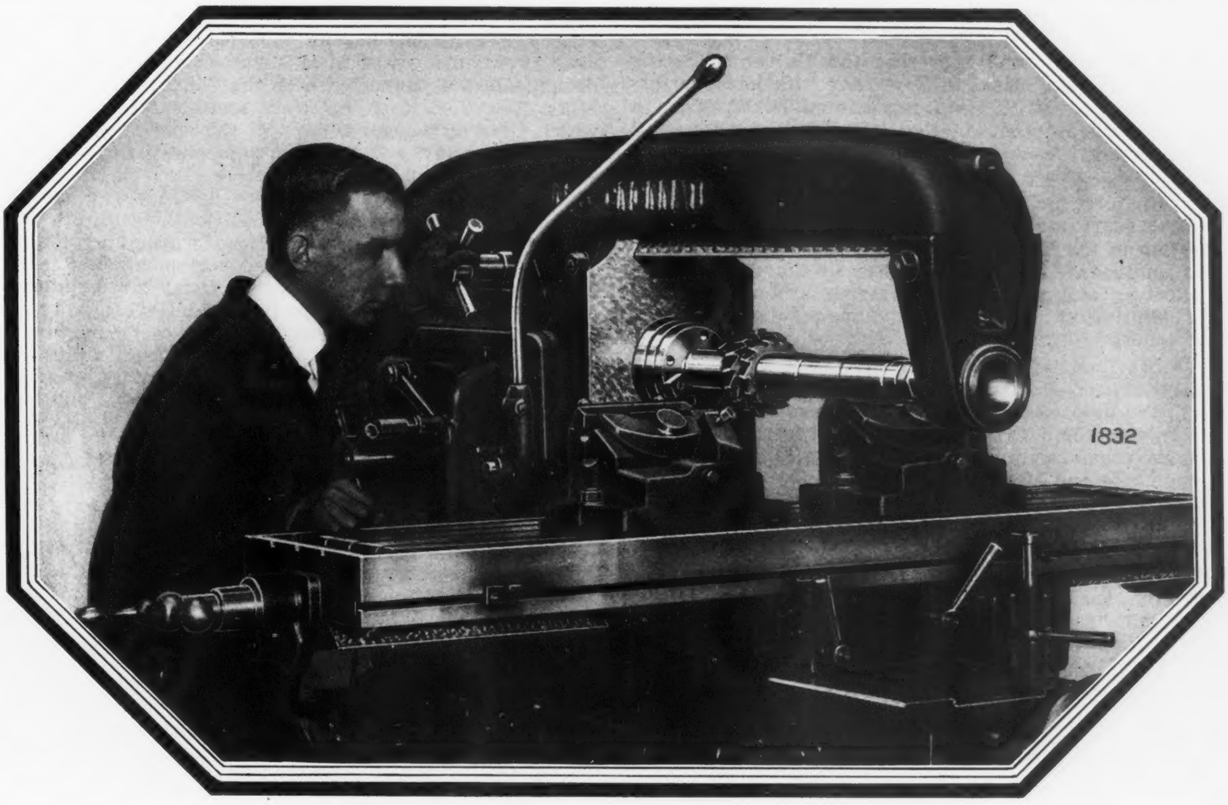
Bicknell-Thomas Co., Greenfield, Mass., has been reorganized with the following officers: President and treasurer, Leon E. Turner; secretary and mechanical engineer, Herbert M. Darling; directors, Leon E. Turner, Herbert M. Darling, Winthrop T. Noyes, and Maurice J. Levy. The new organization will continue to manufacture the Bicknell-Thomas line of tapping machines, reversing tapping attachments, tap chucks, releasing tap-holders, and thread lead indicators, as well as to take in contract work and build special tools and machinery.

Samuel Harris & Co., 114-116 N. Clinton St., Chicago, Ill., jobbers of tools and supplies, are celebrating their fiftieth anniversary. The firm was started by Samuel Harris in 1874, with only a small show case from which he sold tools made in his kitchen. The business rapidly increased, and Mr. Harris became associated with many of the large manufacturers who are now represented by his company. The company has always carried a large stock of tools, and is now taking on many new lines, such as transmission equipment, steam specialties, and machine tools.

Barber-Colman Co., Rockford, Ill., has purchased the entire line of grinding machines formerly built by the Webster & Perks Tool Co., of Springfield, Ohio, consisting of universal and plain grinding machines. In this purchase was included all drawings, patterns, tools, rough castings, and finished parts, as well as a quantity of completed machines. The completed machines are now marketed by the Barber-Colman Co. as Webster & Perks machines, but will carry the regular Barber-Colman Co. machine tool guarantee, having been again inspected and tested under belt in the Barber-Colman plant.

Superior Steel Products Co. has been organized to manufacture cold-finished steel in standard and special shapes, screw steel, shafting and polished rods, round, hexagon, flat and square cold-drawn steel bars, finished steel plates, and other steel products. The company has purchased a factory site about 800 feet long, in Monaca, Pa., and will soon start the erection of a building, 300 feet long and 60 feet wide, of modern, fire-proof construction. The officers of the company are as follows: President, M. P. Simpson; vice-president, William Elmes; treasurer, Homer H. Swaney; and secretary, F. H. Guppy.

Reed-Prentice Co., Worcester, Mass., announces in connection with the personal item appearing in April Machinery, relating to G. J. Hawkey of the Cleveland Duplex Machinery Co., who is now representing the Reed-Prentice Co. in the Cleveland territory, that this information should be supplemented by the statement that the Cleveland Duplex Machinery Co. is the exclusive agent for the Reed-Prentice Co. in the Cleveland territory for all types of standard and special machinery pertaining to the automotive industry, and that Mr. Hawkey is the representative of the Cleveland Duplex Machinery Co. specializing on Reed-Prentice equipment.



One Hand Shifts the Overarm

Here is setting up convenience—an easy turn of the wrist, adjusts the Cincinnati Rectangular Overarm. No stretching or straining. Just a turn of the pilot wheel and the overarm slides on its scraped bearings.

The arbor support with its adjustable bronze bushing, slides snugly over the arbor bearings, the overarm is quickly locked by two conveniently located bolts and the machine is ready for the cut.

Particularly in the tool-room, this Cincinnati convenience is a real time and effort saver. Think what it would mean on *your* work. Send for the special booklet fully describing other equally valuable features on our No. 2 and No. 3 High Power Rectangular Overarm Millers.

ENGINEERING SERVICE

From your blueprint or sample part accompanied by brief data, our special engineering service department will give you a complete estimate including time studies, sketches of fixtures, descriptions of operations and quotations. Our recommendations are based upon our experience with leading manufacturers on this particular engineering service work for the past eleven years.

Send for an estimate blank—fill it out—return it—we'll do the rest.

THE CINCINNATI MILLING MACHINE COMPANY
CINCINNATI, OHIO

CINCINNATI MILLERS

PERSONALS

J. Arthur Deakin will represent the Universal Boring Machine Co., Hudson, Mass., in New York with headquarters at 150 Nassau St. Mr. Deakin represented H. W. Ward & Co., Birmingham, England, in the United States for several years, and later became associated with Isbeque, Todd & Co., of Brussels, whose New York office was closed April 1.

H. H. Valiquet, for the last eighteen years chief engineer of the B. S. Sturtevant Co. (Chicago Division) will join the organization of the Kirk & Blum Mfg. Co., Cincinnati, Ohio, as chief engineer. He will specialize in the designing of dust collecting and pneumatic conveying systems; drying, heating, ventilating, cooling, and fume-removal systems; and air conditioning systems.

G. A. Sawin, assistant to the manager of the supply sales department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., has been elected chairman of a new section of the Electric Power Club. This section includes instruments and instrument transformers. Mr. Sawin, who is chairman of the Instruments and Measurements Committee of the American Institute of Electrical Engineers, has also been appointed chairman of the institute's section for revising its standardization rules pertaining to instrument transformers.

Dr. Kotaro Honda, professor of physics and metallurgy at the Research Institute of Iron, Steel, and Other Metals, Sendai, Japan, has been visiting the various industrial centers in the United States on his way to spend the summer in Germany, France, and England. Traveling with Dr. Honda are two of his associates, lecturers in metallurgy—Hiromu Takagi and Tokujiro Matsushita. These men have been the guests of various chapters of the American Society for Steel Treating in the industrial centers they have visited.

W. H. Rastall, chief of the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C., will sail on June 3 for Europe, with a view to gathering first-hand impressions as to the conditions of the market in Europe for American industrial machinery. Mr. Rastall expects to visit Great Britain, France, Italy, Germany, Poland, Austria, Czecho-Slovakia and Jugoslavia. While he does not plan to visit Russia, he will call upon machinery dealers who are catering to the Russian market. It is estimated that Russia bought machinery in the United States during 1923 for from $3,000,000 to $5,000,000, and the prospects are that purchases amounting to still higher figures will be made during 1924.

Charles F. Smith has recently become associated with the Garvin Machine Co., New York City, for the development of automatic machinery used in the manufacture of paper products, articles formed from wire or sheet metal, etc. Mr. Smith has had an experience covering a period of over twenty-five years in this particular phase of machine design. He was connected with the Continental Paper & Bag Mills, New York City, for eight and one half years, during which time he designed many of the special machines used by that company, and later was associated for twelve years with the Howland Bag & Paper Co., Dexter, N. Y. He recently installed the complete equipment for a new plant erected by that concern. In addition, Mr. Smith was in business for himself for several years designing machinery of the same class. Among his developments are machines for packing matches and chewing gum; for forming automobile tire chains, pins, and hooks and eyes; and for cutting, folding, and gluing envelopes. These machines range in weight from 500 pounds to several tons. In the field of technical literature Mr. Smith has collaborated in an extensive treatise on the design and construction of cams.

OBITUARIES

Michael E. Duggan, for many years a well-known contributor to Machinery's pages, died March 23, in St. Catherine's Hospital, Kenosha, Wis., from pneumonia. Mr. Duggan was born in Chicago, on April 12, 1861, and lived in that city until about fourteen years ago, when he went to Kenosha to take charge of the pattern department of the American Brass Co.'s plant. His specialty was patternmaking, and many of his articles in Machinery reflected his ability to develop new methods and to distinguish between essentials and non-essentials in pattern and foundry work. His articles will be missed in the future by many of Machinery's readers.

C. L. Prince, for twenty-five years associated with the General Electric Co., in iron foundry work at Schenectady, and one of the pioneers of the American Foundrymen's Association, died in Schenectady March 20, at the age of sixty-seven, following a three months' illness. Mr. Prince was born in Georgetown, Mass., and was graduated from the Ridgewater State Normal School and the Worcester Polytechnic Institute. He went to Schenectady twenty-five years ago as superintendent of the General Electric Co.'s iron foundry. Previous to that he was employed by the Camden Iron Works of Camden, N. J.

John H. Lord, who had been associated with Joseph T. Ryerson & Son, Inc., of Chicago, Ill., since 1906, died on March 30, at Louisville, Ky., aged fifty-three.

COMING EVENTS

MAY 6-8—Annual meeting of the Chamber of Commerce of the United States at Cleveland, Ohio. Further information may be obtained from the secretary of the Chamber of Commerce of the United States, Washington, D. C.

MAY 7—Meeting of the Milwaukee Section of the Society of Automotive Engineers in Milwaukee, Wis. Subject: Fuels.

MAY 14—First annual convention of the Ohio Federation of Foremen's Clubs, in Dayton, Ohio. President, T. B. Fordham, superintendent of the Delco-Light Co., Dayton.

MAY 19-21—Joint convention of the Southern Supply and Machinery Dealers' Association, the National Supply and Machinery Dealers' Association, and the American Supply and Machinery Manufacturers' Association, in Cleveland, Ohio; headquarters, Hotel Cleveland. Secretary-treasurer, F. D. Mitchell, 1819 Broadway, New York City.

MAY 19-23—National automotive service convention and automotive maintenance equipment show in the General Motors Building, Detroit, Mich. Further information can be obtained from the National Automobile Chamber of Commerce, 366 Madison Ave., New York City.

MAY 22-23—Spring sectional meeting of the American Society for Steel Treating at Moline, Ill., with headquarters at the LeClaire Hotel. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

MAY 26-29—(instead of 19-22)—Spring meeting of the American Society of Mechanical Engineers at Cleveland, Ohio. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 4-6—Eleventh annual foreign trade convention in Boston, Mass. O. K. Davis, India House, Hanover Square, New York City, secretary.

JUNE 11-18—Convention and exhibit of Section V Mechanical, of the American Railway Association in Atlantic City, N. J. Secretary, V. R. Hawthorne, 431 S. Dearborn St., Chicago.

JUNE 11-18—Convention and exhibit of the Railway Supply Manufacturers' Association in Atlantic City, N. J. Secretary, J. D. Conway, 1841 Oliver Bldg., Pittsburg, Pa.

JUNE 12-14—Fifth annual conference of the National Association of Office Managers at Niagara Falls on the Canadian side. Secretary, T. G. Woolford, Retail Credit Co., Inc., Atlanta, Ga.

JUNE 23-27—Twenty-seventh annual meeting of the American Society for Testing Materials, in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

JUNE 24-27—Summer meeting of the Society of Automotive Engineers at Hotel Monmouth, Spring Lake, N. J. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

JUNE 30—JULY 12—World power conference in London, England, at the British Empire Exhibition, in cooperation with technical and scientific institutes and industrial organizations. Further information may be obtained from Calvin W. Rice, secretary of the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

SEPTEMBER 22-26—Sixth convention and international steel exposition of the American Society for Steel Treating, in Boston. Secretary, W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio.

OCTOBER 3—Aeronautic meeting of the Society of Automotive Engineers at Dayton, Ohio. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

OCTOBER 13-18—Twenty-eighth annual convention and exhibit of the American Foundrymen's Association in Milwaukee, Wis. Secretary, C. E. Hoyt, 140 S. Dearborn St., Chicago, Ill.

OCTOBER 21-24—Production meeting and machine tool exhibition of the Society of Automotive Engineers at Detroit, Mich. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

NOVEMBER 18-19—Service engineering meeting of the Society of Automotive Engineers at Cleveland, Ohio. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

DECEMBER 1-6—Third National Exposition of Power and Mechanical Engineering in the Grand Central Palace, New York City.

ALMOST EVERY DAY

the users of the

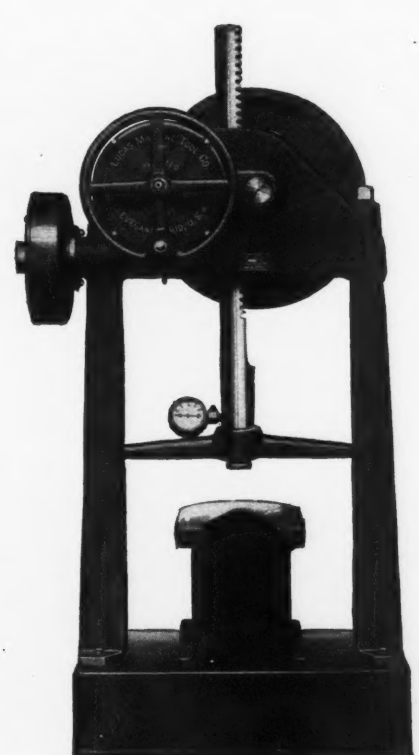
Lucas Power Forcing Press

find some NEW job for it

VERSATILITY "is its middle name."

The Belt does the work, the operator applies and controls the pressure.

The Press AUTOMATICALLY RELEASES the pressure when the operator releases his control or when resistance ceases (as in forcing a bushing or shaft out of a hole). Therefore it cannot "race." Pretty good combination isn't it?



Why not send for a circular?

WE ALSO MAKE THE

"PRECISION"

BORING, DRILLING AND MILLING MACHINE

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich, V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo.

SOCIETIES, SCHOOLS AND COLLEGES

MELBOURNE TECHNICAL SCHOOL, Melbourne, Australia. 1924 prospectus of the Workingmen's College, containing outline of courses, fees, and other related information.

UNIVERSITY OF MISSOURI, Rolla, Mo. Catalogue of the School of Mines and Metallurgy for 1923-1924, containing calendar for 1924-1925, outline of course, and other information pertaining to the university.

NORTHEASTERN UNIVERSITY, 316 Huntington Ave., Boston, Mass. Catalogue of the School of Engineering for 1924-1925, containing an outline of the courses included in both the cooperative and full-time plans, as well as other information relating to the university.

ELECTRIC POWER CLUB, B. F. Keith Bldg., Cleveland, Ohio. Booklet containing the code of ethics of the club, outlining the relations of manufacturers to their customers and the inter-relation of manufacturers among themselves in matters relating to the commercial function.

NEW BOOKS AND PAMPHLETS

EXPERIMENTS ON THE DISTILLATION OF ZINC FROM COMPLEX ZINC-LEAD-SILVER ORES. By B. M. O'Harra and E. S. Wheeler. 44 pages, 6 by 9 inches. Published by the School of Mines and Metallurgy of the University of Missouri, Rolla, Mo.

PRACTICAL EXPERIENCE IN MODERN BUSINESS CORRESPONDENCE. 96 pages, 6 by 9 inches. Published by the Bureau of Commercial and Industrial Affairs, of the Boston Chamber of Commerce, Boston, Mass. Price, $1.

This booklet contains many valuable suggestions on letter-writing, which should be appreciated by all those who have to handle correspondence. It discusses the subjects of correct and forceful expression, the attitude of the writer and the effect on the reader, the importance of appearance, and how to sell by correspondence.

NEW CATALOGUES AND CIRCULARS

J. P. DEVINE CO., Buffalo, N. Y. Circular illustrating the Devine improved inclined tube evaporator.

BAIRD MACHINE CO., Bridgeport, Conn. Circular illustrating Baird wire-forming machines, horizontal chucking machines, and chain-making machines.

E. L. ESSLEY MACHINERY CO., 551 W. Washington Blvd., Chicago, Ill. Pamphlet containing a list of machine tools that this company has in stock ready for immediate delivery.

IRVING-PITT MFG. CO., Kansas City, Mo., manufacturer of loose-leaf binders is distributing a catalogue commemorating the twentieth anniversary of the founding of the concern.

BURY COMPRESSOR CO., Erie, Pa. Bulletins 401 and 407, descriptive of Bury class L power-driven air compressors, and three-cylinder two-stage universal air compressors, respectively.

NEW DEPARTURE MFG. CO., Bristol, Conn. Loose-leaf sheets 161-FE containing an abstract of a paper on angular contact ball bearings presented before the Society of Automotive Engineers.

MONITOR CONTROLLER CO., 500 E. Lombard St., Baltimore, Md. Circular illustrating and describing the Monitor contactor with which the controllers made by this company are equipped.

LINK-BELT CO., 910 S. Michigan Ave., Chicago, Ill. Folder 662, descriptive of the Link-Belt vibrating screen, designed to meet the demand for more effective and thorough screening of fine materials.

S. F. BOWSER & CO., INC., Fort Wayne, Ind. Leaflet containing information on Bowser tanks, including a dictionary of "tankology," which contains definitions of a number of terms used in connection with tanks.

INGERSOLL MILLING MACHINE CO., Rockford, Ill. Circular illustrating the Ingersoll horizontal-spindle heavy-duty rod milling machine at work slabbing and channeling locomotive main rods. The essential data such as feeds, speeds, and production time are included.

O. ZERNICKOW, 15 Park Row, New York City. Circular illustrating speed-recording instruments, including "O-Z" tachometers, tachoscopes, tachographs, and cutmeters, as well as the O-Z dividing machine vises, which are adapted for holding parallel, taper, or irregular shaped work.

BUNDY TUBING CO., 1113 Lafayette Bldg., Detroit, Mich. Pamphlet containing a report made by the Underwriters' Laboratories on Bundy fuel line tubing—a special form of tubing made in both brass and copper, and intended mainly for use on automotive equipment as fuel piping.

READING CHAIN & BLOCK CORPORATION, Reading, Pa. Catalogue 50, covering the Reading line, which includes electric hoists, traveling cranes, multiple gear chain hoists, differential chain hoists, and I-beam trolleys. Price lists and descriptive matter are included for the various products.

MOTORBLOC CORPORATION, Summerdale, Philadelphia, Pa. Bulletin S-102, illustrating and describing the motor-driven chain hoists made by this company. The details of construction are outlined and specifications are given for the complete line, which ranges from 1/8 to 10 tons capacity.

METALS COATING CO. OF AMERICA, 495 N. Third Street, Philadelphia, Pa. Circular descriptive of the "MetaLayeR" Schoop process of coating metals, including recent developments and improvements. The equipment used and practical applications of the process are illustrated and described.

HISEY-WOLF MACHINE CO., Cincinnati, Ohio. Price list No. 29, containing the reduced prices effective March 17 on Hisey-Wolf electric drills, lathes, and grinders. The reduction in price on drills of the most popular sizes is from 12 1/2 to 17 per cent, and many other reductions of from 5 to 10 per cent have been made.

MESTA MACHINE CO., Pittsburg, Pa. Bulletin U-1, containing the results of recent tests made on Mesta "Una-flow" engines for rolling mill service, in which the 40 by 48 engine showed a steam consumption of 14.08 pounds per indicated horsepower hour, and the 44 by 48 engine, a steam consumption of 13.61 pounds per indicated horsepower hour.

GISHOLT MACHINE CO., 1300 E. Washington Ave., Madison, Wis. Circulars SL 12 and 13, illustrating the use of "Simplimatics" in automobile plants. The work turned out on these machines is illustrated by line engravings, and production figures are included. Pamphlet IL-G1A, illustrating and describing the Gisholt internal and link grinder for use in railroad shops.

LOGANSPORT MACHINE CO., 529 Market St., Logansport, Ind. Catalogue R-18, covering the complete line of Logan air-operated devices, which includes chucking equipments for all types of production machines. Illustrations show this equipment applied to various types of machines for which it is especially suited. Copies will be sent upon request to all those interested.

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin 48721, dealing with direct-heat electric furnaces in General Electric factories. The bulletin shows the application of this type of furnaces to various operations, such as annealing of castings and wire, heat-treating, calorizing, sherardizing, etc. Details as to heat, dimensions, and function of each installation are given in descriptive captions.

OILGEAR CO., 398 Thirty-eighth St., Milwaukee, Wis. Bulletins 30, 31, 32, and 33, illustrating and describing new products embodying the Oilgear variable-delivery pump. Bulletin 30 gives specifications of Oilgear broaching and assembling presses; No. 31 covers the type W variable delivery pump; No. 32 describes the Oilgear hydraulic riveter; and No. 33 gives specifications for the Oilgear bench press.

KEYSTONE REAMER & TOOL CO., Millersburg, Pa. Catalogue A10, containing dimensions and price lists covering this company's line of automotive reamers, taps, dies, screw plates, cutters, and small tools. The catalogue also includes such general information as tap drill sizes, lubricants for cutting tools, tables of weights and measures, screw thread definitions, and hints on the care and use of hand reamers, taps, dies, etc.

R. K. LE BLOND MACHINE TOOL CO., Cincinnati, Ohio. Catalogue entitled "LeBlond Lathes in Railway Maintenance Service," illustrating a large number of installations of various sizes and types of lathes in railroad shops. The catalogue contains an outline of the general details of construction of LeBlond lathes, and shows some of their applications to railroad work in prominent American railway systems. The production time and details of the job are included in many cases.

CALORIZING CO., Oliver Bldg., Pittsburg, Pa. Loose-leaf catalogue entitled "The Calco Handbook of Recuperation." This book is more than a mere catalogue, and might more properly be regarded as a text-book on industrial furnace practice. The installation and operation of Calco recuperators are described. A limited edition is available for gratuitous distribution to executives in plants operating oil-, gas-, or coal-fired industrial furnaces. Aside from this, copies may be obtained at $3 each.

R. Y. FERNER CO., 1410 H St., N.W., Washington, D. C. Catalogue 392, descriptive of the high-precision locating and jig boring machines (models 4 and 5) made by the Societe Genevoise d'Instruments de Physique, Geneva, Switzerland, which are adapted for the rapid production of jigs, fixtures, gages, etc., up to 16 by 24, and 24 by 32 inches in size, respectively. The catalogue gives a detailed comparative time-study of the steps followed in laying off, drilling, and boring holes by this and other methods.

GREENFIELD TAP & DIE CORPORATION, Greenfield, Mass. Catalogue 47, containing dimensions, prices, and other information relating to the complete line of gages made by this company, which includes plug and ring gages, special gages, snap gages, and thread gages. In addition to the specifications, general information is included on the use of gages, screw thread terms and their definitions, the measurement of screw threads by means of wires, and various useful tables of thread dimensions and tap drill sizes, standard screw threads, etc.

CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio. Catalogue 40, illustrating and describing the complete line of Cincinnati milling machines, including plain, universal, and vertical machines, and automatic manufacturing machines. Supplementing the data on milling machines, are descriptions on cutter and tool grinders, centerless grinders, and cylindrical grinders. The catalogue contains detailed descriptions of the various types of machines, as well as complete specifications including range, capacity, feeds, speeds, weight and other essential data.